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RESEARCH AND POLICY*

BY E. A. GOLDENWEISER

RESEARCH in a policy-making body is for the purpose of shaping policy. It is the function of the research staff of such an organization to formulate policy, while the responsibility of the executives of the institution is to adopt or reject it. The executives must choose their research man, must back him while he works with them, and let him go when they can back him no longer. This does not mean that they must always follow his advice: they may modify it, or reject it, without interfering with a satisfactory working relationship, but they must have confidence in his competence and integrity; when they lose that the partnership must be dissolved.

This doctrine—stated baldly—may sound novel. It was not so long ago that a line was drawn between research and policy making: research was supposed to deal with facts alone, laboriously compiled, noncommittally presented, with interpretation restricted to indicating the technical limitations of the evidence. Such an extreme view of the limits of the research function could not be and in practice never was enforced. But even its theoretical acceptance had bad effects. It discouraged responsible thinking in the research man, who needs all that he can muster, and encouraged the dangerous but time-honored habit among executives of making decisions on the basis of practical experience, horse sense, or some other euphemism for hunches or smokeroom gossip. Practical policy in order to be sound must be based on technically competent analysis of available facts, leavened by imagination and activated by courage. These are indispensable to the proper weighing of responsible decisions.

Participation in the formulation of vital policies is the lifeblood of constructive thinking. An intellectual eunuch, incapable of experiencing the agony and thrill of vital decisions, cannot be an effective interpreting economist or statistician. This function requires a redblooded person full of energy and creative endeavor.

* This paper is in lieu of the customary Presidential Address, no Annual Meeting of the American Statistical Association having been held in 1943.

The whole is greater than the sum of its parts.—During the past quarter century the relationship between the research staff and the executive has developed markedly in the right direction. It has made particularly rapid strides during the war when tradition and prerogative have had to give way to accomplishment. There are, however, inherent difficulties in the relationship. Executives, even when they are not political appointees, are likely to be drawn from among men who have had much experience in successfully running their private businesses and little experience in public affairs. They have self-confidence based on their success, and the best among them have qualities of decisiveness and leadership. They are likely, however, to lack sufficient appreciation of the importance of basing national policies on broader grounds than individual experiences. There is real danger in experience. It often results in narrowing a public man's approach to national problems to considerations with which he has become familiar in a particular and often not a representative set of circumstances. He finds it difficult to grasp the fundamental truth that in the national economy the whole is far greater than the sum of all its parts.

In the business world there has developed over the years a set of standards which have been tested by experience and found to be effective, particularly in highly competitive local enterprises. These standards are a part of a philosophy the basic tenet of which is that profit is the test of success. They are less applicable to nation-wide organizations, whose success depends on sustained national prosperity, and are generally inapplicable in public service, where the test of success is the public welfare. It is difficult for an executive who steps from private into public service promptly to discard habits of thought that have brought success in the past and to substitute for them the entirely different standards appropriate to his new responsibilities. Directly and indirectly, sometimes bluntly and sometimes subtly, this conflict of standards is a serious obstacle to effective cooperation between the executive and the staff adviser.

Sound theory is sound practice.—But the difficulties confronting the staff man are not all outside of himself. He is likely not to have had many occasions to make important decisions. In most cases he has not learned by hard experience the difference between logical deductions and motivating forces. Basically there is no difference between sound theory and good practice. Both must take into account all relevant factors and their mutual relationships. The apparent difference between the two rests on the fact that, while both are apt to overlook important considerations, those overlooked by one are likely to be different from those overlooked by the other. The theorist, for example, is likely to disregard human factors, while the practical man is prone

to underestimate or not to recognize potent but unfamiliar objective influences. It must be the endeavor of the professional interpreter to grasp the force of the human equation, to make proper allowance for subjective friction in the derivation of motivating forces, just as the executive must learn to measure and evaluate the objective forces at work.

Clarity is not a vice.—The staff man must learn to recognize his own limitations and those of his data. For one thing, facts by their very nature record the past, while decisions relate to the future. For another, the professional jargon that inevitably develops in any much-explored subject is likely to be unfamiliar to anyone outside of the clan. The masonic grip of the economist should be reserved for use within the lodge and should not be introduced into the council chamber. The neophyte sometimes thinks that abstruse terminology is a necessary part of professional competence. As a matter of fact, more often than not it is merely an affectation, a bad habit, which covers up undigested thought. Frequently it is a substitute for clear thinking rather than a means of implementing it. Clear understanding, a thought-out grasp of a problem, can nearly always find expression in simple, direct, and nontechnical language.

Confusing the foreigner.—Perhaps the clearest and most timely example of confusion created by terminology is in the so-called saving-investment analysis. The basic concepts in this analysis are both simple and true. The theory is that income received by a people must be disbursed again—either for consumption or for capital formation. Otherwise the income withheld will diminish the total income stream and on the next round there will be less income to distribute, and a deflationary spiral is likely to start. This is in substance a sophisticated version of the element of truth contained in the time-honored popular saying that spending is a social virtue since it puts money into circulation. Every student of economics in his freshman year has been taught, and I dare say is still taught in most classrooms, that this doctrine is fallacious. But then, this is not the only thing taught to the freshman that the graduate student finds it necessary to discard or modify. The popular theory, which in its homely garb has been excluded from the elementary classroom, has been caparisoned in brand-new terminology and presented with a flourish to the advanced seminar.

There is nothing inherently complex in this theory. The meaning of the terms saving and investment as used in every-day language is clear enough. A person's savings are that part of his income which he does not spend on consumption, while his investments are the part of his saving which he places in income-producing assets. What matters is whether the aggregate of investment by all individuals and corpora-

tions, after allowance for liquidation of investments wherever it may occur, is sufficient to absorb the aggregate of all savings after allowance for deficits that may be incurred by some. If it is not sufficient, there will be a remnant of national hoarding, which will exert a deflationary drag and force income to a lower level. Emphasis on the term national hoarding as the crucial point in the picture would be helpful; it is almost self-explanatory and convincing, because hoarding is generally recognized as a reprehensible habit, while most people are brought up to believe that thrift is a noble virtue.

But the economist as a rule does not present the problem in such simple terms, understandable to the layman and consistent with his usage. The economist uses much more complex definitions and each group of economists, if not each individual one, uses different definitions. Under the spell of these varying uses of terms, some maintain that the volume of savings must equal that of investments, and others that the two will never be the same. While each set of definitions may be logically consistent and as clear as day to its proponent, the debate moves into a rarified atmosphere where the layman dare not penetrate.

Above all, what makes the doctrine unacceptable to the layman is that it appears to condemn what he knows that he as an individual must practice for self-protection, namely, thrift. He cannot be expected to understand easily that, while thrift is a necessary protection against poverty for the individual, an excess of savings by all may result in causing poverty for the economy as a whole. In that case the individual saver may lose far more through unemployment than he was able to save by the exercise of thrift. Neither can he be expected to keep in mind that what is meant is not investment at all, as the layman understands it, but only the total outlay on capital goods. That the heart of the analysis and the threat to economic stability lie in the relationship between aggregate saving by millions of individuals and aggregate spending for capital goods, called investment, is quite beyond the layman's power to comprehend.

While with a little more effort on the part of the staff man these thoughts could be presented to officials simply and clearly, all too often they are stated in seemingly familiar terms without warning that the terms are not used in their familiar sense. This results at worst in complete misunderstanding and at best in unnecessary confusion. Forcing words with well-established meanings into unaccustomed uses is a good example of what Galsworthy calls (referring to the pronunciation of English names) the sound British custom of confusing the foreigner.

The richer—the poorer.—The saving and investment analysis may also serve to illustrate a danger confronted by staff men far greater than mere terminology, namely, the temptation to depend on a simple

formula for the cure of too many varied economic ills. The saving-investment theorem, stated simply, is a formula which, like the quantity theory of money, is little more than a truism. In fact, the great service that this formula has rendered is to release the economist from his imprisonment within the walls of the equation of exchange. And yet, there is danger that it has only released him from confinement within one formula to imprison him within the terms of another. The great difficulty with the quantity theory was that it was based on faith in the mechanical operation of monetary forces; its proponents believe that the volume of money controls prices, and that by controlling prices one can regulate the entire economy. Emphasis on the income flow, as contrasted to the volume of money, represents progress towards a more realistic approach to economic problems, because it takes account of the behavior of humans. But in applying the new doctrine, as the old, the economist should make allowance for the complexity and mobility of economic forces and be on his guard against placing too much faith in causal relationships between terms of a formula.

In its simplest terms the theory is that, if a part of the national income is hoarded, the income flow diminishes and deflation results. But frequently the argument goes further. From past experience and from the analysis of social trends, some conclude that there is a definite relationship between the size of the national income and the volume of savings which is likely to prevail in future years, a relationship according to which the proportion of income saved will rise as income increases. As our productive capacity and our national income increase, there will be an ever-increasing volume of savings. Also, estimates are made of the avenues of investment which are likely to be available into which these savings can be channelled, and it is found that these outlets do not add up to the required total. Thus national hoarding is an enemy constantly lurking behind the scene and preventing the growth of income which our growing capacity would permit. Consequently our actual income will constantly lag behind our maximum capacity. The higher our potential income, the further will we fall short of utilizing our resources fully, and the greater the probable magnitude of unemployment. The richer we grow the poorer we get in terms of jobs for all. The only way out of this dilemma is then said to be compensatory spending by government. This diagnosis has become an argument for a course of action, an argument fashioned at a time when such a course of action was desirable—and, it may be added, was partially pursued but on an entirely different basis.

There is agreement that national hoarding is not consistent with the realization of the maximum level of economic activity and that, if it occurs, it must be counteracted. However, statistical evidence now

available is not sufficient to be the basis of precise predictions as to the future levels of saving and investment and cannot reflect all social changes which the future may bring. The assumption that savings will be far in excess of investment outlets is a hypothesis and as such it needs to be verified by further research and is subject to modification by accumulated experience. Nothing in the history of similar forecasts in the past justifies the acceptance of the assumption as *the* basis of responsible planning or definitive action.

If people save more as income rises, outlets for their savings must be found. While it is true that past evidence suggests that savings habits do not change easily, there is no satisfactory basis for thinking that changed circumstances, particularly a wider distribution of income and wealth and an increased sense of economic security, may not change the ratio of savings to income. Nor is there a basis for thinking that new outlets for investment or new means of spending larger amounts through old channels will not be found. The amount of possible investment in the future is not dependent entirely upon technical progress. It must be viewed with reference to the entire economic setting in which business operates, including prices, taxes, public controls, employer-employee relationships, and numerous other factors that must be taken into account before the formula will be transmuted from a dead and barren phrase into live reality.

Jobs for all—and goods for all.—A practical approach to the problem would be that, since unemployment must not be tolerated in a modern economy, it must be eradicated as soon as signs of it appear. It must not be permitted to start a vicious cycle. Whether this will involve much action by the Government will remain the great unknown in the equation. Certainly, compensatory fiscal policy will be only one among many approaches which public policy will have to make towards maintaining a high and stable level of economic activity. Yet, there can be no doubt that the Government must stand ready to provide such employment as private industry does not supply, and with this in view, it must have plans developed in advance and ready to be put into operation on short notice.

One thing is sure: we do not as yet approach a volume of production sufficient to give everyone a decent minimum standard. Therefore, the remedy must be sought not in the contemplation of increased leisure, but in concentration on efforts to increase the output of goods and to improve their distribution.

This somewhat lengthy detour was introduced to illustrate the kind of pitfalls an interpreting economist must avoid, but in the course of presentation it developed into a statement of a position. Perhaps this

is an unconscious demonstration of how easy it is for an interpreter to be diverted from his original purpose.

Training is a trust.—In addition to avoiding abstruse terminology and inadequately tested formulas, there are other tests to which a staff adviser of a policy-making body must subject himself. He must be sure to gather together, digest, and have command of all available information bearing on the subject under discussion. He must be fully aware of the limitations of this information, of the margin of error to which it is subject. The touchstone of a theory lies in quantitative data, that is, in statistics. Statistics are the economist's conscience. His reliability stands or falls by their verdict. When he disregards them, or misreads them, or improvises them, or stretches them beyond the limits of their capacity—he violates the trust imposed upon him by his training and by his responsibilities.

Policy must rest on forecasts.—The staff man must ponder and comprehend the full import and implications of the problems confronting his principals and of the policies designed to meet these problems. He must be prepared to venture a forecast of future events in case a given policy or its alternative is adopted. Contrary to a commonly held opinion that research must avoid forecasting as a deadly sin, the basic purpose of economic and statistical analysis of social and economic events is to make forecasts. The French saying—to know, in order to foresee, in order to control (savoir pour prévoir, prévoir pour pouvoir) —is a wise one. Unwarranted forecasts must be avoided, and there must be full recognition of the fact that a forecast is a hypothesis and not a fact. But courage to make as good a forecast as available facts and past experience warrant is an essential quality of effective research staff work.

Biases are sirens.—In presenting data to his principals the staff man must avoid a great variety of biases which like sirens tempt to lure him from the journey to his goal. Some of them may be enumerated:

1. The bias of pessimism or optimism. What he says should not be influenced by fearful apprehension or by wishful thinking. He must endeavor to face and appraise the facts no matter where they may lead.

2. The bias of no bias. This somewhat paradoxical bias is both real and common. An excessive effort at being impartial often results in shrinking away from indicated and necessary conclusions. "Yes and no" answers should have no place in a staff man's vocabulary.

3. The bias of accuracy. Accuracy beyond the requirements of the case under discussion may not only delay decisions, confuse the listeners, and burden them with unnecessary qualification, but it may also prevent the reaching of necessary conclusions within the applicable margin

of error. Careful abidance within this margin, on the one hand, and willingness to venture to the limits permitted by it, on the other, are the outstanding characteristics of the expert as contrasted with the amateur in economic interpretation.

4. The bias of consistency. Just because he has said one thing on a previous occasion the staff man should not hesitate to say the opposite if circumstances have changed or if he has become convinced that he was wrong. Many serious mistakes have been made by basing decisions on conditions that no longer prevailed. Winning the last rather than the current war is a habit not confined to generals. Consistency is not only the bugaboo of small minds but the rock on which essential flexibility of policy may shatter. Vested interest in an opinion previously expressed is as dangerous in a staff man as vested property interests are in a judge or legislator.

5. The bias of cleverness. The Russian proverb: "Do not sacrifice your father for a wisecrack" is well turned. Phrases help to punctuate a presentation and to fasten it in the listeners' minds. But they carry a danger of sacrificing clear and straight thinking to the desire to use a telling phrase.

6. The bias of tact. It is essential for a staff man to be sensitive to the atmosphere of a meeting, but he must endeavor not to be dominated by it to the detriment of detachment in his presentation. On the other hand, he should avoid egotism and be willing to give equal weight to a competent judgment, whether it originates with him or with someone else.

7. The bias of logic. Not infrequently a conclusion that flows logically from its premises may nevertheless be wrong—either because the premises have not been adequately examined or because the process of reasoning is too rarified for use in practical affairs. The human equation must be taken into account in all policy recommendations.

8. The bias of originality. Better be right in a conventional way than wrong in a highly original way.

9. The bias of expertness. Methods and devices are no better than the material and the understanding that go into them. Uncritical curve reading is as dangerous to sound conclusions as is a disregard of the sequence of past events. Particularly dangerous are curves that have been corrected, by some device, for the very thing which they are supposed to exhibit. It is not an unusual experience to see an interpreter, who has adjusted two curves for amplitude and direction of fluctuations and for level, stand back and marvel at their close correlation.

10. The bias of omniscience, the gravest of them all. Some principals expect a staff man to know everything, and staff men are likely to dread

admitting that there is something they do not know. It is wise, and it is a part of the job, to know as much as possible about all phases of the subject under discussion. It would not do not to know, or not to be in a position quickly to find out, too many of the ascertainable relevant facts. But neither would it do not to be willing to say "I don't know." Attempts at covering up gaps in his information by more or less hazardous guesses have rightly undermined many a staff man's reputation for reliability.

Importance of being awake.—It has been said that an expert is a person who knows more and more about less and less. The danger that confronts an economic and statistical interpreter is the opposite—he must strive against knowing less and less about more and more. The subjects he must cover tend to comprise the universe. It is essential for him to keep informed about a great many things but not to spread himself so thin as not to know enough about anything to be a dependable guide to policy.

These are some of the biases and difficulties that a staff man must avoid. There are many others. It is clear that he cannot proceed in the rumored manner of a duke who dreamed that he was making a speech in the House of Lords, and when he awoke found to his amazement that he was. He must not be either too self-confident or too reticent; he must be tactful but not timid; and, above all, he must never be subservient. When a staff man begins to shape his opinions in accordance with what he thinks his principals want his usefulness as a public servant is over.

The anvil chorus.—In attempting to acquire the necessary virtues and to avoid the threatening vices a research man has to depend, in addition to searching self-analysis, on contact with his associates and with fellow members of the profession inside and outside of his immediate group. In the final analysis man is dominated largely by the subconscious. Since he cannot be psychoanalyzed prior to every presentation—he must take care to subject his psyche to exposure to others. Out of such contacts alone can emerge a sane appraisal of human problems. And problems of economic policy are human problems whose solution depends on grasping human verities.

THE STATISTICAL PROGRAM OF THE SELECTIVE SERVICE SYSTEM

By Kenneth H. McGill
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Selective Service System

When reference is made to the statistical program of the Selective Service System, it means the effort of National Headquarters to perform a complete statistical service for itself and for the 52 state and territorial headquarters and the 6,441 local boards which comprise the field organization. The operation of the System is entirely decentralized and statistical information is an important medium for coordinating units which are widely separated in time and space.

Under the Selective Training and Service Act of 1940, as amended, the System is charged first of all with the orderly withdrawal of men from civilian life and industrial pursuits for duty with the armed forces.[1] Its statistical program is aimed at supplying the information necessary to this task.

Since data for the planning and operation of the System must be furnished on each local board and also to that board, by far the greater part of the statistical program is devoted to reporting activities. The boards forward to National Headquarters information on the Selective Service classification and the age, race, marital-dependency status, occupation, education, physical, and other characteristics of each registrant. From such information the Research and Statistics Division prepares individual punch cards and provides the following periodic tabulations for each board:

(1) Monthly Report of Classifications by race and marital-dependency status.
(2) Quarterly Report of Classification Actions by race and marital-dependency status.
(3) Annual Report of Principal Defects of Accepted and Rejected Registrants by race.
(4) Annual Report of Occupations of Accepted and Rejected Registrants by industry.

The first two tables cover all registrants within the ages acceptable for induction into the armed forces, but the third and fourth are based on a sample of the men who are given physical examinations at local boards and induction stations. State and national recapitulations of

[1] In addition to the procurement of military manpower, the System is charged with the reemployment of men at the termination of their service with the armed forces.

these local board materials are made along with the special tabulations which are needed.

Equal to the reporting work in importance, though not in magnitude, is the analytical part of the statistical program. This technical phase is concerned with (1) the development of estimates and (2) the accomplishment of research. Both cover a wide range of subjects. An example of the former is an estimate made last July that if induction calls were completely filled during the period July through December 1943, around 446,000 Pre-Pearl Harbor fathers would have to be inducted after October 1. One of the latter is Medical Statistics Bulletin No. 2.

FIELDS

The work of the Selective Service System may be regarded as consisting of three processes: (1) the basic manpower process of registering men and classifying them according to group characteristics, (2) the concomitant one of the occupational or other deferment of men in order that there shall be the least interruption to economic and social life, and (3) the other inherent process of the physical examination for induction or rejection of those not deferred. The reporting and the analytical phases of the statistical program follow this pattern as far as subject matter is concerned. They have their manpower, occupational, and medical aspects and by the time the whole task of Selective Service has been accomplished, each field will have had a period of dominant importance.

The Selective Training and Service Act became effective on September 16, 1940; the first registration[2] under the law was on October 16; and the first induction of a registrant into the armed forces was on November 18. From then until Pearl Harbor and the entrance of the United States into war[3] the calls of the armed forces for men for induction were relatively small.[4] The Army which Selective Service was helping to build was limited by law to a net strength of 900,000 and by appropriation to 800,000. This peacetime era of Selective Service can, therefore, be viewed as one when medical statistics were of dominating interest and usefulness.

The physical, mental, moral, and educational standards of induction were aimed at the very best type of soldier available, and to determine which registrants qualified under these standards, both local board physicians and the medical staffs of induction stations were performing thorough examinations. The combined rejection rate for local

[2] Around 17,000,000 men between the ages of 21 and 36 years.
[3] December 8, 1941.
[4] The average was but 81,000 per month during the entire calendar year of 1941.

boards and induction stations was as much as one-half of the young, single men who made up the vast majority of the selectees examined.

So rigid an application of such high standards was accompanied by differences of determination upon physical examination. The effort of Selective Service, therefore, was toward (1) standardizing local board examination procedures, (2) attaining uniformity from board to board in the results of examinations, and (3) studying and achieving the maximum realization for military service if existing standards were applied to all men of the first and second registrations.[5]

Following Pearl Harbor manpower information became the dominating field of the statistical program. The induction calls upon Selective Service increased from 22,000 in December 1941 to 450,000 in December 1942, or approximately twenty times during a one-year period. In addition the outside limit of the armed forces grew more than tenfold and the responsibilities of the United States as an arsenal of democracy expanded accordingly.

Then on January 1, 1942, a month after Pearl Harbor, local boards were directed to confine their physical examination activities entirely to the detection of venereal disease and 141 manifestly disqualifying defects. The induction stations were to assume the sole responsibility for the thorough examination which both boards and stations had previously been performing.

Later the third, fifth, and sixth registrations, held respectively on February 16, 1942, June 30, 1942, and in December 1942 and following, added 12,000,000 militarily liable registrants.[6] This together with the 18,000,000 of the first and second registrations made a total of 30,000,000 men between the ages of 18 and 45 years who were liable for service with the armed forces. Early in December of 1942, however, the armed forces terminated the induction of men aged 38 and over. This reduced the military manpower pool to 22,000,000 of the ages 18 through 37.

While these factors served to increase the demand for medical data, they also developed the need for information on classification, occupation and dependency at a much more rapid rate. As the competition of the armed forces, the manufacturing industries, and agriculture for men has become keener so has the need for this kind of manpower data.

[5] The second registration was held on July 1, 1941, and covered approximately 800,000 men who had become 21 years old since the first registration.

[6] A fourth registration was held on April 27, 1942, and covered 14,000,000 nonliable men aged 45 to 65 years. The third registration covered 8,000,000 aged 20, 21, and 37 through 44; the fifth 3,000,000 aged 18, 19, and 20; and the sixth, those 18 year olds who were unregistered in December 1942 and those who attained that age thereafter.

The demand for it will probably continue until the maximum strength of the Army and Navy has been reached.

When the war is over and military demobilization is in progress, the emphasis of Selective Service statistics will be on occupational data. As has already been mentioned, the System must not only procure men for the armed forces, but it is charged with the responsibility of finding employment for each man and woman released from service when they are physically qualified for work.

DEVELOPMENT

Developmentally speaking, the statistical program of the Selective Service System got under way in the fall of 1941. National and State Headquarters and local boards had been engaged in some statistical work since the first registration.

One item of the early work provided a limited amount of information for planning and operating purposes. This was a monthly report on the Selective Service classifications of registrants by race, which was prepared by the local boards themselves and forwarded to State and National Headquarters. It was in operation intermittently from March 1941 through June 1942, a little over a year. Problems of (1) adequacy, (2) comparability, (3) flexibility, (4) accuracy, (5) promptness, and the like served to discourage the use of this summary type of reporting. As a result a decision was made in the summer of 1941 to develop a system of individual punch card records on each registrant, to have these cards available at National Headquarters, and to produce such data from them as were required both routinely and specially for the entire System. In arriving at this determination National Headquarters held extended consultations with a statistical advisory committee, the staff of the Division of Statistical Standards in the Bureau of the Budget, and other specialists in the field.

Following the decision to abandon the summary report approach, the Division of Research and Statistics at National Headquarters was reorganized into (1) a divisional office, (2) an analytical branch with medical, occupational, and manpower sections to cover the three major aspects of Selective Service, and (3) a tabulating branch with machine, manual, and control sections. The task of the new division was to arrange for securing, processing, and utilizing a statistical record on each of the eighteen million men then registered. It must not only maintain a basic file on every man but it must also keep such record current at least with reference to the registrant's Selective Service classification.

The magnitude of this program and its continuing time factor offered

a peculiar challenge. Although it appeared to be unique among statistical activities, those charged with its development began to explore their own experience for methods of accomplishment. This staff had been drawn from the Public Health Service, the Department of Agriculture, the Work Projects Administration, various college faculties, the War Department, the Social Security Board, the Bureau of the Census, the Bureau of Employment Security, and other Federal Agencies. Its advisory committee, which had also been enlarged and reconstituted, came from equally varied sources.

There began the technical planning of the project. Should this continuing central inventory, which Selective Service System was establishing, use somewhat the same techniques as the mechanical reporting system for venereal diseases developed by the Public Health Service? What were the related procedures used in the National Health Inventory of five million cases? Did the accounting system of the Agriculture Adjustment Administration have applicable elements? Were there similarities between the records program of the Social Security Board and the reporting activity of Selective Service? What of the periodic reports of the Work Projects Administration, the individual files on Army men at The Adjutant General's Office, the work of the decennial Censuses, and the information set-up of the Employment Security Bureau?

From what registrant records should the basic punch cards be prepared? How would changes of status be secured to keep them current at least as to Selective Service classification? What techniques would merge these changes with the basic record in the most expedient and efficient manner?

In the fall of 1941, which is the time the individual records approach was being developed, National Headquarters was receiving a copy through State Headquarters of but one report on the registrant. This was his *Report of Physical Examination and Induction* which was prepared on each registrant placed in Class I for induction processing. The advantage of this form for statistical purposes lies in the fact that it is almost entirely filled out by the examining physician and the local board clerk, whereas most registrant records are prepared entirely by the man himself. To provide information on the physical and mental defects of registrants examined under the existing high standards, punch card processing was immediately begun on a sample of these forms.[7]

Obviously this medical reporting form would be available only for physically examined men and at that early date not many more than

[7] For additional discussion of the medical statistics work, reference is made to Folk, O. H., "Selective Service's Medical Statistics Program," this JOURNAL, December 1942, Vol. 37, pp. 425–429.

three of the eighteen million had been so processed. The only other sources of information on registrants who had not yet been physically examined were in their local boards. The processing to which local boards subject them, was, therefore, reviewed and all of the various data by-products were considered.

When a man registers, his board prepares and files a *Registration Card* for him, but this record does not contain enough information to provide an adequate basic punch card for a central reporting system and besides there is but one copy of the form.

Next, the board serializes the registration cards and lists them by serial number for the purpose of assigning order numbers. This *List of Registrants* is likewise inadequate for use in preparing a punch card but it offers a reference covering all registrants. In addition, copies are available in both the boards and State Headquarters. National Headquarters, therefore, secured copies for the first and second registrants; and, following Pearl Harbor, arrangements were made for them to be submitted routinely as the third, fourth, fifth, and sixth registrations were held.

After a registrant is given an order number, he is sent and must prepare and return a classification form known as the *Selective Service Questionnaire*. This form contains information adequate in scope for a basic record, and just before Pearl Harbor, National Headquarters was about to request local boards to prepare precoded abstracts of each of these classification questionnaires.

When the United States entered the war, however, it became evident that Selective Service must undertake an occupational inventory of its forty-four million registrants. This inventory was conducted by means of a *Selective Service Occupational Questionnaire* which each registrant filled out for his local board. A part of this form was detached by the board and forwarded to National Headquarters for punch card processing. The problem of a basic individual record had, after a fashion, been solved.

From this material came tabulations on (1) the selected occupations or critical and essential skills of registrants by region, state, and industrial area and (2) on Selective Service class and marital-dependency status by state and local board. The former were used by Selective Service in connection with its occupational deferment activities and also by other federal and state agencies concerned with problems of manpower. The latter were applied by Selective Service as a more specific basis for the state and local board allocation of calls which were made upon it for men to be inducted into military service.

The Selective Service System now had an individual medical punch

card for a sample of physically examined registrants and a second punch card record for almost every registrant[8] covering his other characteristics, such as, Selective Service class, age, race, marital status, dependency, education, work status, employment class, selected occupation, etc. This had been accomplished without material interruption to the entire operation of the System, an important matter in connection with as rapid and as extensive a program as that of Selective Service. In other words the collection of data from the field and its return to the field in tabulated form had been developed as an integral part of the whole operation.

It still lacked one item, however, of performing the task for which it was created. This was the all important one of current information on the registrant's latest Selective Service classification about which the entire effort of allocating and meeting calls is organized. The classification process is the technique through which the Selective Service System operates to build the armed forces through an orderly withdrawal of men from civilian and industrial activities.

The problem of a registrant's current class was solved by substituting a single form, *Local Board Action Report*, for three forms already in use. The new form served to transmit to National Headquarters, after each local board meeting, the new class assigned to a registrant at that meeting. From this form are tabulated the monthly accountings of registrants by classification, race, and marital-dependency status for the nation, each state, and each local board. It also provides monthly tables showing the classification process by similar units of the System, that is, the classes from which registrants are taken and into which they are placed.

OPERATION

The foregoing on the development of the statistical program of the Selective Service System may have given some indication that the operation of this program involves many problems. The System had been functioning for more than a year and using statistical information in its work. National and State Headquarters and local boards were interested in having new and more comprehensive data.

Special requests for operational and planning statistics began to arrive in quantity. After Pearl Harbor they increased greatly in proportion and there they have remained. As is always the case with figures that are to be used, the great majority of such requests were accompanied by a deadline. Decisions on policies and procedures can

[8] The Occupational Questionnaire was not prepared by registrants who were already in the armed forces at the time of the survey.

wait only a limited time for data. The statistical activity of the System had to attain production in that respect or become fallow.

The requests from within the System ranged from ascertaining why a given local board was relatively low in the proportion of registrants inducted, to estimating what would be the effect upon the farm, factory, and fighting front if the induction of Pre-Pearl Harbor fathers was limited by law to those under 30 years of age.

An ever recurring task has been the study of the defects of men rejected for military service and their prospects for acceptance under actual or proposed changes in physical standards. Since the number of these rejections aged 18 through 37 has now reached 3,500,000 and fathers are being drafted, the importance of the subject has caused Congress to legislate for a five-man medical board to study the physical standards of the Army and Navy. To date most attention has perhaps been given to rejections for educational deficiency, venereal disease, teeth, psychoneurosis, eyes and ears. Regarding syphilis and teeth, considerable progress has been made in getting standards revised for the acceptance of men with these defects.

Naturally studies of the occupations and industries of registrants have always been of concern. Occupational bulletins and lists of deferrable occupations have been issued for the guidance of the System in its deferment work. A constant question has been, under present procedures for occupational deferment, how many farmers and how many factory workers will be deferred in three, six, twelve, or eighteen months. What will the occupations of the latter be? What will the occupations and industries of inducted registrants be for the same periods? How many men will the replacement schedules and manning tables yield for induction and from what part of the industrial and occupational pattern will they come?

Another item which has required continuous attention is that of the most equitable method and data to use in allocating calls for induction among states and local boards. Estimates on the number of men to be secured for the armed forces from the registrants not yet inducted or enlisted have likewise been in constant demand. And when the induction supply of single men without dependents was running low, studies were required on the date when single registrants with collateral dependents would have to be processed. Similar studies were needed when it became apparent that married men with wives only would have to be inducted and also when the same situation developed for registrants with children.

An outstanding example in analytical work is a one per cent sample study of the local board files of the Occupational Questionnaires for the

first registration. This study was made after these registrants had been the subject of Selective Service processing for two years and some of its more pertinent findings were:

(1) One registrant in three was under 26 years of age but more than half of those inducted and enlisted by September 1, 1942, were in this age group.
(2) One-third were unmarried, whereas almost 9 in 10 of those in the armed forces by the end of the second year had this marital status.
(3) Approximately 1 registrant in 9 was a Negro; although only 1 induction in 11 was a Negro, a higher proportion of Negroes than whites had been processed toward induction to obtain even this induction ratio, due to differences in rejection rates.
(4) The heaviest withdrawals through induction or enlistment have been from the less essential occupations such as clerical, sales, and domestic and other service workers.
(5) Approximately 2 in 3 claimed qualifications in one of 190 essential war occupations, but only 1 in 15 of those inducted into the armed forces made such claims.

While these results were obtained from a sample study designed primarily to aid in the operation and planning of Selective Service, certain of the data collected may appeal greatly to research workers. The punch cards contain the registrant's marital status, the number of children reported by him, whether he lived with his dependents or not, the types of schools he had attended and the highest grade completed, the occupation and industry in which he was employed at the time of the Occupational Inventory, and whether or not this occupation was the occupation for which he judged himself to be best fitted.

In addition, the card has such items as qualifications in one of the 191 occupations and 35 professions considered essential to the prosecution of the war, and if qualified, whether the registrant was working at one of them. The study also provides such other data as the number of registrant inmates of institutions; the number unable to work, the number reporting that they did not want to work; and the number working for wages, working independently, neither hiring nor being hired, and working as proprietor or employer. All of these characteristics can be made specific by race, citizenship, age and place of residence.

Special reports on this and similar studies have already been prepared covering the aspects important to Selective Service. As time and opportunity permit, others will be undertaken. They should prove to be an important cross-sectional view of American men in time of war.

Interest in the data and studies of the Selective Service statistical program is not all confined to the System. The materials have been and will be made available outside the organization for manpower studies, for Census estimates, for statistical research, for postwar planning, for

occupational and industrial study, for research in housing, public health, and medicine and for a great variety of other subjects in which Selective Service has the concern but not the facilities for participation.

In addition to the analytical phase of operating the statistical program there has also been the mechanical problem of securing and tabulating the routine reports from the local boards. As has been seen, reporting forms had to be revised or developed to provide a basis for mechanical processing. A manual of instructions for local boards to use in preparing forms had to be issued. Even then employment turnover and other factors among the compensated clerks of the System's 6,441 local boards have caused some interruption in the flow of reports to National Headquarters. A similar situation has existed with reference to the submitting of correct information.

On the other hand State Headquarters and local boards have had limited difficulty in understanding and applying the periodic tables and special materials from National Headquarters. This has occasionally required field attention by the regional officers of Selective Service and members of the Research and Statistics Division. Further, the matter of getting the data reported promptly and accurately has been the occasion for considerable correspondence. In a decentralized operation of 6,441 local units, there is always someone who forgets or who fails to understand.

At the beginning of the individual records work the monthly classification tables for each board, which were prepared from its individual classification reports, were superimposed upon the summary reports previously submitted by the board. This, together with the initial trouble of securing the individual reports on time and correct in detail, made for significant accumulative errors in the tabulations of some boards. A complete inventory of all militarily liable registrants, which the System later undertook, was used to adjust the basic items of Selective Service class, marital-dependency status, and date of birth on the individual punch card at National Headquarters and to complete this file for registrants not covered by the occupational questionnaire. This meant the coding and punching of 30,000,000 additional cases in a relatively short period of time. State Headquarters and local boards had become dependent upon their machine records and could not be kept waiting for their monthly reports.

Operating the tabulating part of the program called for procedures on receiving, controlling, editing, coding, filing, punching, sorting, and tabulating. Many of these and especially the machine processes were innovations. They were designed to fit a particular situation, to handle volume and to attain speed during a period of personnel and equipment

shortage. It might be mentioned, however, that with all the ingenuity exercised on procedures, the tabulative phase might not have been possible of undertaking except that the System was fortunate enough to absorb the staff and machinery—900 employees and 20 tabulators—of a processing unit of the Work Projects Administration.

Because of the intensive application of personnel and equipment and the changing character of the Selective Service program, no statistical procedure designed to serve it can remain fixed for any great length of time. The Selective Service process is a dynamic one. Since Pearl Harbor it has been under constant pressure from the war with the enemy abroad and the drive for food and manufactured goods at home and has been in a state of continual adjustment with reference to these three factors. In consequence, the statistical work of the System is also dynamic in character.

THE SOCIAL VALUE OF AGRICULTURAL STATISTICS

By Walter H. Ebling
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Less than one-fourth of the American people now live on farms compared with about three-fourths a century ago. As the bulk of the population is now removed from the land, it necessarily has become more dependent for its food and fiber upon that portion which remains on the farms. In time of peace and the usual agricultural abundance, we take our food supply as a matter of course, and our urbanization and specialization are looked upon as evidence of progress. In wartime when some basic items become scarce, many begin to worry as to whether there will be enough to go around, and they read with a new interest the reports on crops and the prospects for farm production. Citizens know that our food rationing and point values must have a statistical base, and that data on farm production and on stocks of food products are basic to plans and programs concerning such commodities.

So in our modern world the data on agriculture, like agriculture itself, are basic to our thinking as well as to the controls exercised over things we use. Just as a continued and dependable flow of food and fiber from the Nation's farms is vital to our way of life, so a continuing knowledge of the ever-changing prospects in the many-sided farming industry is a matter of public concern. Except for their greater intensity in wartime, the social interests in agricultural data during such disturbed periods are also those of peacetime: their use in government, in commerce and industry, in the press, in schools, and by agricultural leadership being perhaps the most commonly known. While only a small percentage of the population makes direct use of agricultural statistics, all are affected by them daily.

I

Statistically, agriculture presents an extremely varied universe, even when looked at from the standpoint of a single state as well as when considered for the United States as a whole. According to the last census, this country had over 6 million farms, each of which is an individual unit subject to various degrees of control by the operator, as well as subject to many changes arising out of natural forces which are largely beyond the operator's control. Not only are there a great many individual producing units, but they are scattered widely over the 48 states. This introduces the whole range of geographic and economic

patterns, which complicates immensely the task of measuring quickly both the short and long-time changes in this far-flung industry.

After the basic levels of the farm inventory and output are established periodically by enumeration or other means, measurement of change from these levels is a continuing process. Some of the changes in agriculture are slow, while others are rapid and unpredictable. In whatever way these changes are measured, the problem is always a vast one and much more difficult than the measurement of changes in the concentrated units found in most other industries. To record at one time the output changes for a group of mills or mines is a simpler task than for a vibratory biological universe made up of more than 6 million unlike and widely scattered farms, most of which produce many kinds of products.

The types of data needed on agriculture are many. This country officially undertakes to keep track of the acreages and the production of over 80 crops, as well as of the numbers and output of the various species of animals and the production of animal products. It is not enough to know what the past and present supply situations are, but measures of prospective production and of probable future supplies are also of great importance. After all, the total supply of food, fiber, and other things from the farms is made up of quantities carried over from the past as well as those available from present production; and the adequacy of current supplies is in large part determined by the prospects for the visible future. In addition to the question of supply of farm products, there are increasing needs for data on prices, wages of farm labor and other costs, land values, and various other items that may reflect the industry's changes, capacity, and outlook. The measurement of all of these at regular intervals, year in and year out, presents one of the large fields in statistics, and one in which the public interest, while always present, is intensified during wartime or other periods of unusual disturbances such as depression years. Agriculture is not only a source of supply, but an important market for the products of other industries, and the buying power of farmers is at all times important to the national economy.

Because there is this wide public interest in basic data on agriculture, the collection of such material became a government responsibility long ago. Such data can have both proper and improper uses and the public interest requires that they be impartially collected and dependably interpreted.[1]

[1] In the first monthly crop report of the United States Department of Agriculture on July 10, 1863, Isaac Newton, the Commissioner of Agriculture, wrote "Those who produce and those who consume have interests as well as the purchaser who stands between them. A knowledge of the market is essential to all . . ."

II

Attempts to compile agricultural statistics go back more than a century into American history, and farther in Europe. In the United States, an agricultural enumeration was included for the first time in the Census of 1840 after a period of agitation for an inventory of the resources of the United States, of which agriculture was at that time perhaps the major one. A unique book by Archibald Russell[2] in 1839 summarized this early thinking and urged a program, which it took decades to accomplish. Such an undertaking was also suggested in the President's message to Congress in 1838.[3] Russell's volume was prophetic of things to come.[4] The author of the book realized that before studies of the economy could be made, primary data had to be collected, and it was his purpose to advocate a broad program of agricultural data, only a part of which was undertaken in the Census of 1840 but which was in the main achieved in subsequent census enumerations. Concurrently, there came also an effort to collect statistics on agriculture through the Patent Office.[5]

While the inventory concept to set forth the resources of the country received major emphasis, along with it there was also the search for agricultural markets and for more knowledge of the competitive situation in farming as it was then developing because of the expanding production in the new colonies which brought price pressures upon the established farmers in the older areas. This was the era when the early agricultural societies flourished. In dealing with the problems of agriculture one of the objectives of these early societies became that of providing more information on production and about markets and how to reach them. Out of these efforts came also a new concept of data needs, namely, that of the changing seasonal situation during the growing months of the year and the current prospects of production throughout the country. This thinking was crystallized in the efforts of Orange Judd, the Editor of the *American Agriculturist,* when he undertook in 1862 through his paper to collect monthly data on the condition of

[2] *Principals of Statistical Inquiry as Illustrated in Proposals for Uniting an Examination into the Resources of the United States with the Census to be Taken in 1840,* published by D. Appleton and Company, New York, 1839.

[3] A message to Congress by President Martin Van Buren on December 3, 1838, in which an expansion of the census is suggested as follows: "In recommending to Congress the adoption of the necessary provisions at this session for taking the next census, or enumeration of the inhabitants of the United States, the suggestion presents itself whether the scope of the measure might not be usefully extended, by causing it to embrace authentic statistical returns of the great interests specially intrusted to, or necessarily affected by, the legislation of Congress."

[4] Archibald Russell. Page 1, "The study of statistics, whether from the light which it throws upon the social relations of society, or the information it imparts regarding its political condition, is highly valuable and instructive."

[5] It was largely through the personal interest of Henry Leavitt Ellsworth, the Commissioner of Patents, who got an appropriation for agricultural statistics from Congress in March of 1839.

crops in this country, and also to bring together what information he could on conditions in foreign countries with an eye to prospects for export markets. This project by the *American Agriculturist* was the forerunner of the government program of monthly crop reports which was one of the first things to be initiated after the establishment of the United States Department of Agriculture in 1862. The first government crop report was issued in July of 1863, in the midst of the Civil War, and since then major advances in this field frequently have been associated either with the urgent needs of war periods or with other periods of difficulty, such as the depression of the past decade.

Broadly speaking, all groups in society have had an interest in the data on agriculture. The early urging for more specific information on the farming industry came largely from agricultural groups who in studying their problems felt that they were handicapped by inadequate knowledge of the competitive situation arising out of the size and location of the various parts of their industry. They also wanted quick information on what was going on in the industry during the producing seasons so that the individual producers might make adjustments in their plans as soon as a broad knowledge regarding the current situation could be had. In addition to the older producer interest in such data there has more recently developed the consumer interest as well. This has been manifest most in periods of shortage and through trade activity which reflects consumer demand and the problems of supplying such demands. In emergency periods, such as the present war, food problems are sure to receive greatly increased emphasis, and with such periods come greatly increased demands for agricultural data of all kinds. These have a broad social motivation because in such times society as a whole is more apprehensive of scarcities of farm products. Then, too, as the Nation has become more industrialized, questions of food costs and supplies have become increasingly matters of public and political action.

III

Two main sources of data on agriculture have been developed in the United States: the enumerations by the census at fairly long intervals such as five and ten years, and the continuous activity of data collection, largely sampling, by the federal and state Departments of Agriculture. The former establishes many of the basic benchmarks by enumeration and the latter measures the continuous changes from these benchmarks and supplies such series as prices, seasonal changes, stocks, and many other items needed to round out the field. The Department

of Agriculture's work is now largely cooperative with the states which contribute in various ways.

The program of decentralization and state cooperation was made possible by the establishment of state officers about 1913. While the work of collecting agricultural data was originally a federal activity centered in Washington, some of the states had also developed agricultural enumerations usually through assessors. State agencies have definite need for agricultural data and the trend has been toward decentralization away from Washington through the building up of cooperative federal-state field units. As decentralization progresses the national work is becoming the sum of the activities at the state level to an increasing extent and the work in Washington has become a smaller part of the total. In this respect the federal agency has been fortunate in establishing cooperative relations early with most of the states, largely along the pattern first evolved in Wisconsin in 1917. The experience with such cooperation during World War I and in the period following has shown its advantages. The Nation is today much better served in this field than would be possible by a federal agency operating alone. It is fortunate, too, that this development came before the present immense expansion in federal agencies, because now such cooperative relations in the states would probably be more difficult to achieve.

In depression periods some new demands for agricultural data have taken varied forms, such as the needs for handling credit, agricultural surplus control, and other efforts to mitigate the effect of excessive supplies of farm products. Drought periods requiring relief measures have called for special types of data usually on an emergency basis. Action programs by the government in the past decade brought a number of new needs for data and they have resulted in new responsibilities. In wartime, on the other hand, there are periods of scarcity and action programs to increase production again present special problems. Programs for expanding farm output are based upon a knowledge of the existing situation. Even such projects as the establishment of war bond quotas for the rural areas are expedited when they rest upon a well-considered statistical base.

In the main, the public interest in this field has grown more slowly in peacetime and most rapidly in periods of war or other emergencies. Even so, there has been important peacetime progress and some major developments have come during such periods. The establishment of the United States Crop Reporting Board about 1906 and the initiation of the work on agricultural prices about 1908 were among the important forward steps which came in peace years.

IV

With the trend in recent years more toward a planned economy in agriculture, additional needs for detailed data have become apparent. The early developments in agricultural statistics were quite broad and general. The depression of the '30's led to various programs of agricultural production control. In the beginning these dealt mostly with the control of acreage of such crops as wheat, cotton, corn, tobacco, sugar beets, and others, and also with hogs, in the markets of which the price situation had become unsatisfactory and corrective measures were undertaken in the form of attempted production controls. Allotments were undertaken to limit acreage for various crops and also for numbers of hogs through the Agricultural Adjustment Administration. Loans on crops by the government were used in years of low price. In the carrying out of these programs, the needs for agricultural data increased more than in any previous time. Data on the commodities involved in the programs were usually wanted on a county basis and check data were desired even down to individual farms. Data available varied greatly in different parts of the country, but they were best in some of the more important agricultural states where annual enumerations by assessors were available. However, county estimates of acreage and production for some crops were undertaken in all states, as well as county estimates for certain livestock items. While data which had been collected for other purposes were often inadequate for these new needs, much was accomplished and workers in the field generally saw new horizons.

In the adjustment programs of this era there also was involved the concept of parity prices and there were programs of parity price payments to producers by the government. These were based primarily on the data on agricultural prices which had been collected by the Department of Agriculture. Annual price data on the leading agricultural items had been collected since 1866, and a program of the collection of monthly data had been initiated through the efforts of Nat C. Murray about 1908. The familiar 1910–14 base period so widely used in price indexes was also used as a basis for calculating most parity prices. This five-year period was employed because when World War I broke out there were available in the Department of Agriculture as a result of Mr. Murray's work approximately five years of fairly complete monthly price data on agricultural products. Prices paid by farmers, were also reported during the same period, but these were less complete. Even so they were the only data available and ways were found of using them. Beginning just prior to 1930 the collection of price data

which had been mostly conducted in Washington was decentralized to the state offices, which made possible some expansion of detail and larger samples.

V

More recently there has been a reversal of the government sponsored reduction programs in agriculture which characterized much of the depressed decade of the '30's. In World War II there has come an increased demand for agricultural products, and in spite of a series of remarkably good years of farm output, there are shortages. This has affected both producer and consumer psychology, and extensive programs to increase production of food for war needs have been undertaken under government leadership. In these all-out food production programs, output goals for farm products were first set up by the Department of Agriculture in 1941 for 1942. These war food production programs, like the earlier scarcity programs, rested upon a statistical base using the most recent estimates for commodities as established by the Department of Agriculture's Bureau of Agricultural Economics and its cooperating state agencies. Again there was an intense need for detailed data which would make it possible to work with the national production estimates and goals by states and counties. This work was expedited greatly by the experience of the decade of the '30's which had brought more detailed agricultural data through their use in the agricultural adjustment programs aimed at production control. While these farm programs have been initiated in Washington, they have been increasingly decentralized to the states and collection and handling of agricultural statistics is now largely being carried out in state offices. The goals of agricultural production established in Washington for 1944 because of wartime needs have been reworked by state committees which have determined finally what the proper objectives for the states should be. A further step is to break state production goals down into goals for subdivisions of states, such as counties, and to work with local agencies and farmer groups in efforts to achieve these goals.

Recent developments have brought the interests of both the producer and consumer groups close together. After all, war food production, like the war itself, is everybody's problem and food production is basic to our war effort. It is vital to the civilian population, the armed forces, and to the lend-lease arrangements with our allies. Though in the early days the collection of agricultural data was primarily motivated by the problems of producers and producer groups, it has now become vital to the thinking of all groups, producers and consumers alike. As the country has become more commercial with

fewer people on the farms and an increasing portion away from the soil, periods of cr[illegible] such as the present war make them more conscious of the food pro[illegible]ns. Our social welfare and our morale can be affected by food su[illegible] and food prospects, and only through some far-flung system[illegible]antly measuring agricultural changes can the basic facts be known.

VI

Perhaps another subject in which agricultural data play a vital part should be mentioned, and that is the regulation of consumption. In a war period such as the present, shortages are inevitable and the once abundant food supply of this country has been no exception. For decades we took our food supply as a matter of course, seldom having occasion to worry about it in this country. In spite of the recent record production years, the enormously expanded requirements of World War II have outrun the supply.

In order that available supplies of scarce or badly distributed items might be equally distributed among the population, rationing programs have been necessary. Government agencies have undertaken to conserve food and to build up stock piles and reserves against future needs. More and more, a detailed knowledge of what our supplies are and what the prospective supplies are likely to be in the predictable future, is basic to our thinking. No rationing program could be intelligently undertaken without some knowledge of supplies, even as to quantity, quality, and location. The building of stock piles and the reserves assumes a knowledge of supply and prospective needs, and plans for the future must be based upon a knowledge of past production and of demands and the possibilities of meeting them. Commitments, too, will arise in the way of international collaboration on food supplies which can only be made on the basis of reasonably accurate knowledge of what we have, and what we are likely to be able to produce in the predictable future.

In the war food programs of the past two years, certain production materials have definitely been limiting factors in the farm output. Farm labor, farm machinery, feed, fertilizer, and some lesser items have been so scarce as to make their distribution a primary problem. Here again, the need for data on which distributions could be based has been urgent, and rationing programs were undertaken for farm machinery which undertook the distribution of available new equipment to the points where it would be the most productive. Critical feed supplies, lumber for farm buildings, copper wire for the wiring of electrical installations in farm buildings, and other items had to be alloted to areas

where they would accomplish most from the standpoint of the Nation's needs. Programs of supplying agricultural labor through the United States Employment Service and through the Agricultural Extension Service were based as much as possible on the data indicating the areas of greatest need. Some new material has also been assembled for this purpose in addition to the established series. In many of these new needs, agricultural statistics of a detailed nature were used as tools for doing a job in the public interest, and the last Congress strengthened the work by unifying and increasing its budget.

PROBLEMS IN ESTIMATING FOOD PRODUCTION IN WARTIME

By Joseph A. Becker
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The Department of Agriculture has been engaged in the preparation of estimates of crop and livestock production for a great many years. Impetus was given to this work by each of the major wars in which the Nation has engaged. In fact, the Department of Agriculture was founded in 1862 during the Civil War and one of its first undertakings was the compilation and publication of information upon crop prospects and production. The first appropriation for collecting agricultural statistics was made in February of 1863 and the work was continued in a modest manner through the years that followed. There was a gradual expansion in the scope of the work and a gradual improvement in estimating methods. Important advances were made in the initiation of monthly reports on prices in 1908 and the publication of quantitative forecasts of crop production in 1912.

The crop reporting work experienced a material expansion during World War I, taking on at that time the estimation of additional commodities such as fruits, vegetables, and livestock products, as well as the reporting of stocks of agricultural commodities. Important segments of work begun during the war had demonstrated their usefulness and were carried on after the war ended. The agricultural crisis of the early twenties also gave stimulus to the whole field of agricultural statistics, as administrators and researchers sought for its cause in the field of supply, demand, and price. A rapid growth took place in information relating to production, stocks, and prices. The field of reports on livestock and on livestock products was developed in this period. The depression of the thirties called for agricultural statistics in great detail, as the agricultural programs were developed on a state and county basis. In the two years of World War II that have elasped since the country became defense-conscious and then war-conscious, there has been greater public recognition of the importance of the official crop and livestock reports. Demands made for additional series and for precision in the estimates will justify their use in administrative action as well as for general information purposes.

In peacetime the public—farmer, merchant, consumer—is the most important user of crop and livestock information. Individuals bought and sold their products, raw or processed, in a relatively unrestricted market on the basis of all information available. For such use, estimates and forecasts of crop and livestock production were among those most

commonly used. Economists in the Department and in the colleges also were important clients. They used crop and livestock reports in their analyses—they advised the farmer and the public of the economic importance of the facts available to them. In recent years the economists of the action agencies of the Government have made intensive use of these data in an administrative manner in working out and adjusting their programs.

All of these clients found the information useful in relation to its precision. The public reaction to the economic appraisal of a particular situation affected the supply and demand of the commodity, or more precisely, the offerings and takings and the price. An error or lack of precision in the estimates eventually was caught up in the equilibrium that takes place in the operations of a free market.

In a wartime economy, the need for precision increases. Particularly is this true when governmental controls come into being in many phases of the Nation's economy. The public is still a client, and individuals formulate bases for action in the market as before, but their freedom of action is restricted. The economists of the Department and the colleges are still clients and their analyses and conclusions are more closely watched. The roles of the administrators of action agencies become more important and their need for precision in the estimates is enhanced. If it is the job of the administrator to allocate the supply of a commodity, he wants to be reasonably certain that his allocations will come out fairly even with the supply. If it is his job to stimulate the production of a commodity, he wants his background information to be precise.

These underlying changes are basic to the needs which develop in wartime and which have been manifested in the increased demand for estimates, the increased detail desired, and the increased scrutiny given to them.

With respect to estimating methods, the Crop Reporting Board continues to tap the same sources of information, with modifications brought about by war conditions. The greatest source of information is the farmer himself and the principal medium is the mailed inquiry. Estimates of acreage and of livestock numbers are based upon samples of the individual farms obtained in varying numbers at various times of the year. The most extensive are the Rural Carrier samples of livestock numbers obtained in June and December and of acreage harvested obtained in October. Each Rural Carrier is given 10 to 20 cards to distribute to farmers on his route. In areas where farmers are not served by Rural Carriers, the distribution is supplemented by direct mailings. The farmer is asked to fill out the card for his own farm and

return the card to his mail box. These returns have been found to be more nearly representative of all farms than any other extensive sample. They lack enough in representativeness or in randomness to make the job of estimation a continual challenge to the statisticians of the Department who utilize the returns.

The next source in size is the list of a quarter-million farmers to whom are mailed similar cards relating to their intentions-to-plant as of March 1, and relating to actual plantings as of mid-June. These inquiries are the basis of the Prospective Plantings Report and the July estimates of acreage for harvest, respectively. The Prospective Plantings Report had its inception as an outlook report for the benefit of farmers. It was designed to provide a composite picture of farmers' plans early enough in the season, so that desirable changes might be made to prevent over-production or under-production. The July acreage estimates serve as the acreage bases for the season's forecasts of crop production. More extensive in total numbers, but limited to 32 states, are the Assessors' totals of livestock assessed for taxation, and, limited to 13 states, the Assessors' enumerations of crop acreage. For certain crops, as for cotton and for corn in the "commercial" corn areas, extensive data are also available from the Agricultural Adjustment Administration records.

Important in the forecasting of crop production and in measuring milk and egg production are the 80,000 regular crop reporters who receive a general crop and livestock inquiry each month. In addition, there are dozens of lists of special reporters who furnish information on a multitude of subjects.

Personal interview by full-time employees relating to specialized crops such as vegetable crops grown in concentrated areas for shipment by truck and refrigerated cars are still relied upon, but this approach is necessarily on a restricted scale during wartime. Telephone and telegraph have to a considerable extent replaced intensive personal surveys, though occasional visitation must be continued to keep these important contacts active.

Much information is obtained from dealers and processors in farm commodities but with increasing difficulty, since these business men are short of help and are asked by other agencies of the Government to file reports and answer detailed inquiries on matters which are important to the war effort.

During recent years certain activities have been carried on which provide objective measures of crop production. Among such activities are the crop meter frontage measurements, cotton boll counts, pre-harvest wheat surveys, etc. These activities entail the extensive use of automo-

biles and have all been discontinued for the duration. Considerable experimental work with enumerative surveys has been conducted as a basis for testing the enumerative approach and the size of sample needed to obtain the specified degree of precision. An example of this was the 19-county survey in which a complete enumeration was obtained for each farm in each of 19 counties scattered throughout the North Central States. Extensive sampling tests were carried on to determine the size of sample needed to prepare reliable county estimates. Among the results of this study was the conclusion that a geographic unit of land such as the square mile section or quarter section would give the greatest precision in preparing estimates of crop acreage. This conclusion was tested out on a state-wide scale in the Indiana-Iowa Section Sample Surveys of 1940 and 1941, the results of which so far have been reported only in preliminary form. Monthly surveys of farm economic phenomena were made in Iowa in cooperation with the Agricultural College. Enumerative surveys relating to farm labor were made in the spring of 1942 in New Jersey, North Carolina, Florida, Texas, and California. Much was learned about sampling techniques in these various studies. Practically all such enumerative surveys have also been discontinued for the duration, but knowledge of sampling problems has been increased and the results have been helpful in evaluating the mailed surveys.

The mailed surveys have been continued as the principal source of information about agricultural developments. Naturally, the Board is greatly concerned about the kind of sample it provides during wartime and how the sample behaves. We have not had a great deal of experience with such samples under wartime conditions. The sampling of acreage and livestock numbers on individual farms was in its infancy in the crop and livestock estimating work at the time of World War I, as other methods were then in use. Experience to date during World War II confirms the stepping up in the spirit of cooperation among farmers, which also was characteristic of World War I. An ordinary questionnaire stated in simple form and sent at an opportune time brings a high rate of return. Undoubtedly, patriotism is a motivating force. On the other hand, a questionnaire reaching the farmer at an inopportune time when he is rushed in doing a war job of production with a war-reduced force may be neglected and the results may fall below those obtained in peacetime.

In peacetime, the returns to a mailed inquiry are self-selective—the farmers who reply have bigger and better farms, they have more livestock, they obtain higher yields of crops, and produce more livestock products than does the average farmer. Allowances are made for these

disparities in the estimating process. A favorite device is to use successive inquiries to measure change from month to month or from year to year, tying these changes back to a base figure at a date when a complete or nearly complete enumeration was made. Generally speaking, these bases are the enumerations taken by the Census at five-year intervals. In some states, there are the annual enumerations by the Assessors. For some commodities like rice and sugar beets, there are complete enumerations of receipts by processors. All such check data are historical in nature. Consequently, the results are not available until after the current reporting season is over. Where such annual enumerations of acreage or production are available, it is of course possible to calculate the regression of the universe upon the sample and utilize this regression in forecasting what the universe will show. Further illustrations of selectivity in the samples are the monthly measures of milk and egg production. Seasonality is involved and the check data are not too conclusive in appraising the degree of departures of the samples from average seasonality. In other words, it is difficult to measure how much more milk and how many more eggs are produced on the crop reporters' farms in the winter period, the season of low production. We know no more, or for that matter no less, about this selectivity in wartime than in peacetime. We find it necessary to go ahead on the basis of past experience which is largely peacetime experience. During 1943 certain check data, such as Assessors' enumerations and processing plant totals, became available for checking the production in 1942. These data gave some measure of selectivity in the samples which were collected.

In the field of forecasting and estimating crop yields, the Board did have experience during World War I. Then, as now, the crop reporters' "judgment" returns of condition and probable yield were used to prepare forecasts and estimates. A review of the information for the years 1917 and 1918 indicates some tendency toward overstatement of condition and yield. This also may have had its impetus in patriotism—in part an urge to make a good showing and in part an expression of determination to do all things necessary to accomplish a record output. Although it is not too conclusive, the evidence at least compels the Board to include the data for World War I years in the record which is used for preparing the current estimates. Just as in the field of the estimates of acreage and livestock numbers, the final check data for 1943 will give some additional information for use in 1944. Each additional year's experience should help improve the estimates in the remaining months, or years, of World War II.

A STATISTICAL ANALYSIS OF RECENT CHANGES IN COMMODITY PRICES AT WHOLESALE

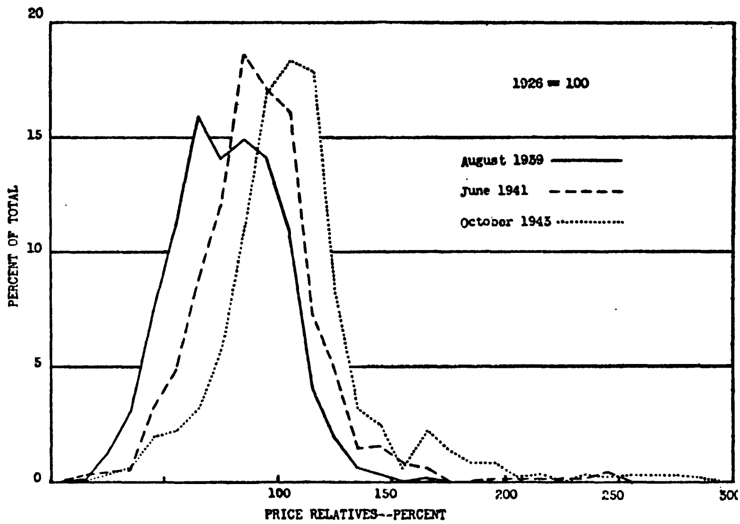
By Leonard Ascher

The rise in wholesale prices shown by the United States Bureau of Labor Statistics index of wholesale prices has been accompanied by a number of other price phenomena. This article will present some other aspects of price change that have come with the rise in that index.

As the first step in this study of prices, tabulations were made by months of the price relatives published by the United States Bureau of

CHART I

FREQUENCY DISTRIBUTIONS OF PRICE-RELATIVES OF WHOLESALE PRICES



Labor Statistics[1] covering the period of January 1937 through October 1943. Of the frequency series which were thus secured, three were selected and their frequencies expressed as a per cent of total frequency to put them on a comparable basis. Graphic presentation of these distributions is made in Chart I.

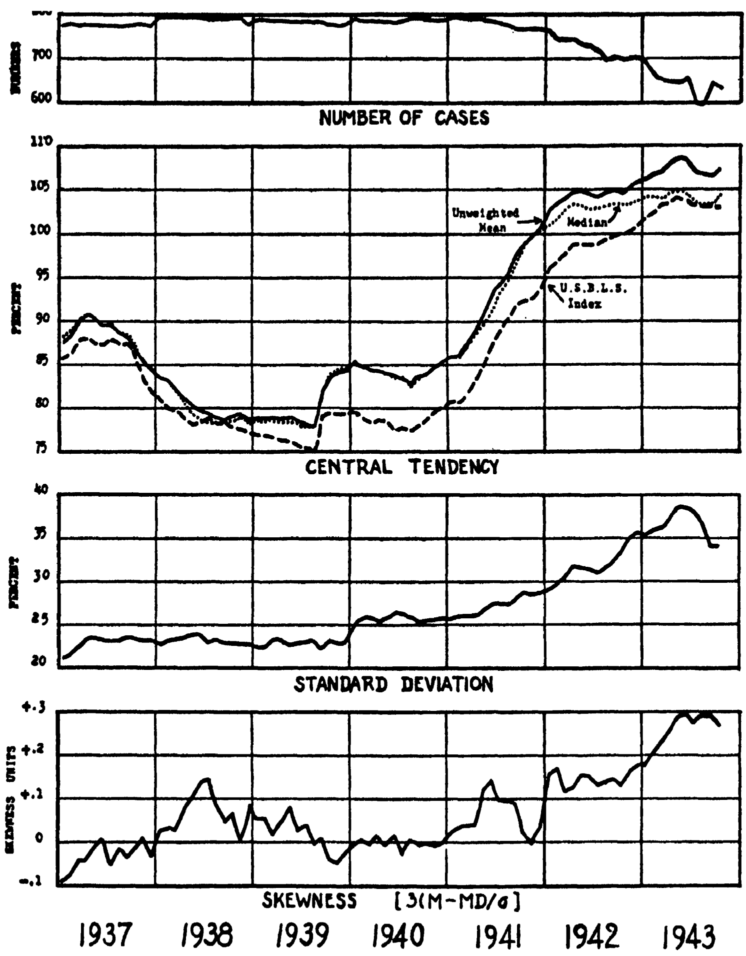
For each of the eighty-two monthly distributions of price relatives, the arithmetic mean, median, standard deviation and coefficient of skewness were computed. These measures, together with the number of

[1] United States Bureau of Labor Statistics, *Wholesale Prices*, Washington, D. C. June 1937, December 1937, June 1938, December 1938, June 1939, December 1939, June 1940, December 1940, June 1941, December 1941, June 1942. Data for the months of June 1942 to October 1943, were taken from the mimeographed releases entitled, *Average of Wholesale Prices and Index Numbers of Individual Commodities*, issued by that agency. For an analysis of price-relatives to 1937 see Leonard Ascher "Variations in Price-Relative Distributions, January 1927 to December 1936," in this Journal, Vol. 32 (June 1937), pp. 271–280. The desire to carry the analysis on from the point where the previous article left off explains the use of January 1937, as the starting point of the price-relative part of this study.

CHART II

MEASURES CALCULATED FROM PRICE-RELATIVE DISTRIBUTIONS, AND U.S.B.L.S. INDEX OF WHOLESALE PRICES. JANUARY 1937 TO OCTOBER 1943

1926=100



cases in each distribution, are shown in Chart II. The marked changes that have occurred, especially since the end of 1940 are clearly apparent.

Attention is particularly directed to the decline in number of price relatives reported since that time. This loss in numbers[2] has been as great as 200, and is sufficient to detract appreciably from the significance of the price relative distributions as a continuing series, a fact which should be kept in mind in interpreting results secured from them.

The disappearance of a large number of price series previously used in the index has emphasized the problem of replacing the losses with new data. This replacement is done by "splicing" new series into the index,[3] by "interpolation" and by estimation of values to replace the missing data.[4] An analysis of the information in the price bulletins reveals that there were in October 1943 quotations for 417 of the 813 series used in August 1939, indicating that at least 396 substitutions or other devices were necessary to compute the index for October. In addition, there were gaps in the new series which have been added to the list of commodities on which the index is based which raise the total above 400. In short, at least 45 per cent of the 889 price series used in the index have been war casualties.

The comparison between the index of wholesale prices and the unweighted arithmetic mean of price relatives reveals a spread of approximately five points since September 1939, and a smaller difference prior to that date. The medians of the price relative series followed the means quite closely until 1942, when they began to move to a lower level nearer to the weighted index. The unweighted means have of course been influenced by the extreme increases in prices, while the medians have been less affected, and the weighted index has evidently been least influenced of all. Caution must be used, however, in making comparisons between means, medians and index because the latter is based upon a longer list of commodity prices than the distributions of price relatives.

The rise in these measures of central tendency has been due to a general rise in prices. Of the 417 price series for which quotations were given in both August 1939 and October 1943—85 per cent showed increases, 4 per cent showed decreases and 11 per cent showed no change.[5]

[2] Price relatives are not given for all series for which there are price quotations.

[3] Cf. Jesse M. Cutts and Samuel J. Dennis, "Revised Method of Calculation of the Wholesale Price Index of the United States Bureau of Labor Statistics," in this JOURNAL, Vol. 32 (December, 1937), pp. 670–674.

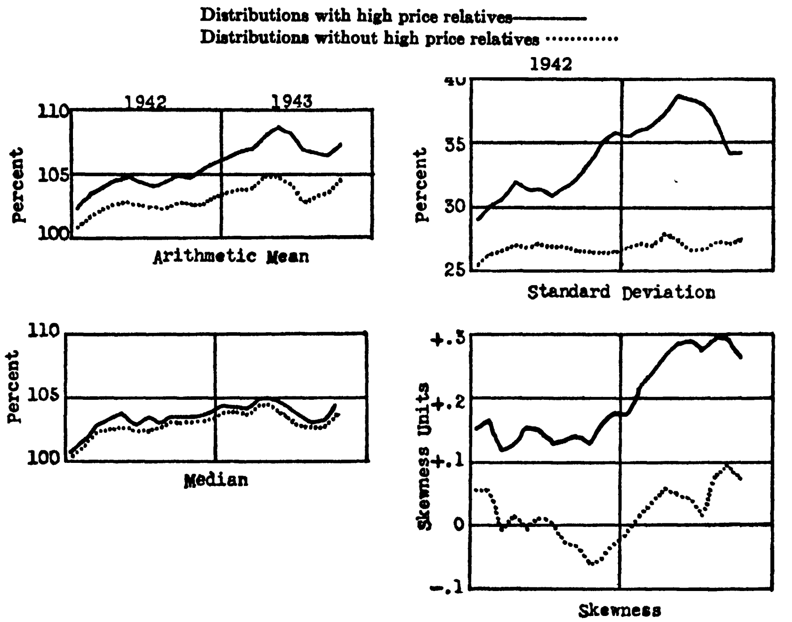
[4] This information was obtained directly from the Bureau of Labor Statistics.

[5] Between April 1942, when the General Maximum Price Regulation went into effect, and October 1943 there were 167 price increases, of which 83 were in the Farm Products and Foods groups, 98 decreases, of which 27 were Farm Products and Foods, and 566 unchanged prices, of which 19 were Farm Products and Foods. Of the total of 831 commodities for which quotations were given in both months referred to, 20 per cent increased in price, 12 per cent decreased and 68 per cent showed no change.

A hint of which commodities were most influential in bringing this rise is found in the list of commodity groups whose prices have consistently risen higher than the index of all commodities at wholesale. These are grains, hides and skins, cattle feed, dairy products, other farm products, woolens and worsteds, other textiles, cotton goods and lumber.

CHART III

THE EFFECT OF A FEW EXCESSIVE PRICE INCREASES ON PRICE RELATIVE DISTRIBUTIONS. JANUARY 1942 TO OCTOBER 1943



Other subgroups, such as oils and fats, have at one time or another risen higher than the index. These may be identified in the table, which arrays the Bureau of Labor Statistics sub-indexes of wholesale prices. These sub-indexes are shifted to an August 1939 base, and arrayed, with the number 1 given to the highest value in the array, and 47 to the lowest. Sub-indexes which have risen above the index of all commodities are marked by an asterisk beside their order numbers.

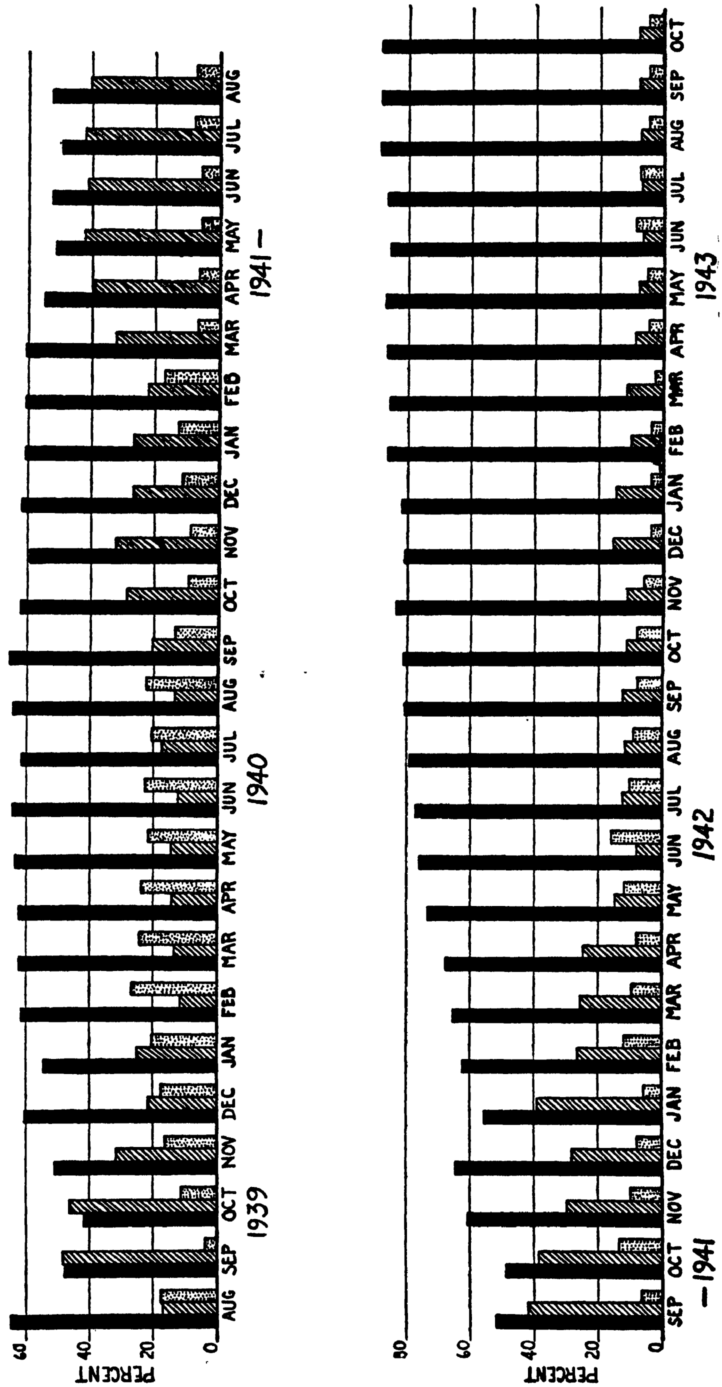
Since 1941, with the sharp rise in measures of central tendency, the distributions have also shown increases in dispersion and skewness. These increases have been due largely to the rise in prices of a few commodities which have imparted a "tail" to the distribution of prices, a phenomenon which appeared in 1940 and developed greatly after mid-1941. If all price relatives above 200 per cent of 1926 are excluded from the distributions for the months since December 1941, and mean, median, standard deviation and coefficient of skewness for each modified

CHART IV

CHANGE OVER PREVIOUS MONTH

WHOLESALE PRICES – ALL COMMODITIES AUGUST 1939 – OCTOBER 1943

UP DOWN UNCHANGED



ARRAY OF SUB-INDEXES OF WHOLESALE PRICES AT SELECTED DATES
(August 1939 = 100)

Sub-index	Dec. '39	June '40	Dec. '40	June '41	Dec. '41	June '42	Dec. '42	June '43	Oct. '43
Grains	1*	3*	3*	3*	3*	5*	4*	3*	2*
Hides and skins	2*	17*	4*	4*	8*	11*	13*	14*	13*
Cattle feed	3*	4*	2*	10*	2*	2*	3*	4*	3*
Other textiles	4*	5*	9*	2*	7*	10*	12*	11*	12*
Oils and fats	5*	8*	27	1*	1*	1*	1*	1*	1*
Rubber	6*	1*	7*	8*	14*	17*	16	16	16
Dairy products	7*	16*	6*	15*	12*	15*	9*	9*	10*
Woolens and worsteds	8*	9*	8*	13*	13*	13*	14*	15*	14*
Cotton goods	9*	22*	11*	5*	4*	6*	8*	8*	8*
Other farm products	10*	7*	12*	12*	6*	8*	6*	6*	5*
Non-ferrous metals	11*	11*	15*	21	32	35	34	35	36
Cereal products	12*	12*	31	24	18	23	19	19	18
Paper and pulp	13*	6*	10*	17*	16*	18	20	18	17
Lumber	14*	20*	1*	9*	11*	14*	15*	13*	11*
Other foods	15*	30	16*	7*	9*	12*	10*	10*	9*
Fertilizer materials	16*	26	20*	33	24	28	25	29	23
Fruits and vegetables	17*	2*	26	14*	17*	3*	7*	2*	6*
Hosiery and underwear	18*	35	43	42	38	38	37	37	35
Shoes	19*	13*	21	25	22	19	18	20	21
Other miscellaneous	20*	27	33	31	33	36	33	34	31
Coke	21	19*	18*	18*	27	31	31	32	33
Anthracite	22	14*	13*	23	25	29	27	22	22
Furnishings	23	18*	23	26	28	27	28	30	30
Paint, paint materials	24	24*	29	27	26	21	21	21	20
Drugs	25	15*	5*	11*	5*	7*	2*	5*	4*
Other bldg. materials	26	23*	22	29	31	32	35	39	38
Rayon	27	25*	30	37	40	41	41	41	41
Clothing	28	21*	24	22	20	16*	17	17	19
Other leather products	29	28	32	34	29	30	29	31	32
Electricity	30	44	44	47	47	47	47	47	47
Motor vehicles	31	29	19*	28	19	22	22	23	25
Bituminous coal	32	37	25	30	34	37	32	24	26
Chemicals	33	31	34	36	41	34	36	36	37
Furniture	34	34	37	32	23	26	26	26	27
Petroleum products	35	45	46	20	30	33	30	25	24
Brick and tile	36	38	38	38	39	40	40	40	40
Mixed fertilizers	37	39	35	39	37	39	39	33	34
Iron and steel	38	41	39	40	44	44	44	44	44
Structural steel	39	36	40	43	45	45	45	45	45
Plumbing and heating	40	32	36	35	35	20	38	38	39
Cement	41	40	41	41	43	43	43	43	43
Agricultural implements	42	42	42	44	42	42	42	42	42
Livestock	43	43	17*	6*	10*	4*	5*	7*	7*
Leather	44	10*	14*	19*	21	24	23	28	29
Meats	45	47	28	16*	15*	9*	11*	12*	15*
Gas	46	33	47	46	46	46	46	46	46
Automobile tires	47	46	45	45	36	25	24	27	28

* Sub-indexes so designated rose higher than the all commodities index.

distribution is computed, a different picture is obtained. As Chart III shows, the means so secured are considerably below those computed from the full distributions, the medians are only slightly below, but dispersion and skewness are reduced drastically, indicating that the rises in dispersion and skewness observed in the full distributions were due to the few extraordinary increases. The lowest number of cases dropped was seven, and the highest was sixteen. Six price series were above 200 throughout 1942 and 1943; olive oil, quicksilver, boards and shiplap, China wood oil, cream of tartar and tartaric acid; while apples, cows, hops, alfalfa seed, sweet potatoes, bananas, ethyl alcohol, menthol, sulfur olive oil, and barrels were above the 200 mark for several of the months covered. The diversity of this list demonstrates that the increase in skewness and dispersion in 1942 and 1943 cannot be attributed to any one group of prices, such as farm prices.

A characteristic of the wholesale price list is its relative sluggishness. This is brought out in Chart IV, which shows the proportion of prices which increased over the previous month, the proportion which decreased, and the proportion which remained unchanged. In only five months of the fifty-one months covered in the chart, did more than half of the eight-hundred-odd[6] prices change. In contrast, the proportion of prices which show no change from one month to the next has been consistently high.

Another aspect of the price changes is the interchange in price relationships which has occurred. It is not possible to show this for all the individual commodities, but an indication of what has happened can be obtained by referring to the movement of the prices of commodity groups. Some of these commodity groups have risen in price, others have fallen, and many have not changed; furthermore, the rates of change have varied from group to group. The end result is that commodities have shifted about in the price structure producing a new pattern of price relationships. This is demonstrated in the table, which shows the relative position of the Bureau of Labor Statistics indexes of prices of sub-groups of commodities at specified dates. The lack of consistency in maintaining relative position is apparent in the case of many commodity groups, and in some the changes have been quite marked. In a profit and loss economy in which so much depends on price relationships, these shifts in the price structure are of utmost importance. They are, in fact, probably of greater significance than any other change in price phenomena.

[6] These tabulations of increases, decreases, and no change, were made by the Bureau from the price series actually used in the index of wholesale prices, and included 813 cases in August 1939, but changed to 889 when the basis of the index was changed. These tabulations have appeared irregularly in the wholesale price bulletins, and some of the missing data had to be secured direct from the Bureau of Labor Statistics.

STANDARD COMMODITY CLASSIFICATION

By Vladimir S. Kolesnikoff
United States Bureau of the Budget

The United States project on standard commodity classification is sponsored by the Bureau of the Budget, the War Production Board, and the Procurement Division of the Treasury Department, and is carried on, under the general supervision of the Interagency Committee on Standard Commodity Classification, by a Technical Committee assisted by forty committees of experts.[1]

In the preface to the volume recently published,[2] the purpose of the Standard Commodity Classification is stated as follows:

> Standardization in classification and in presentation of statistical data concerning commodities is urgently needed. At present there are many different classification systems in use by Federal agencies and in some instances different commodity classifications, often noncomparable at many points, are being used within the same agency. The comparability of commodity data and hence their value will be tremendously increased by the use of a standard system of classification and presentation.
>
> The purpose of the Standard Classified List of Commodities is to meet the need for such a system. To the extent that it is uniformly used, it will insure reasonable comparability between the commodity data of separate Federal agencies. Some users may wish to employ both the numbering system and the classification structure of the Standard List. Others will prefer to set up their own codes on bases convertible to the Standard List. But so far as practicable in all cases agencies should present their commodity data according to the arrangement in the Standard Classified List of Commodities.

A discussion of the background, history, and description of the Standard Commodity Classification should help to explain the essential fea-

[1] **The Interagency Committee:** *Stuart A. Rice*, Bureau of the Budget, Chairman; *Major Robert Bruce*, War Dept.; *E. Dana Durand*, U. S. Tariff Commission (*Louis S. Ballif*, alternate); *Howard C. Grieves*, WPB; *V. S. Kolesnikoff*, Bureau of the Budget; *Robert LeFevre*, Procurement Division, Dept. of the Treasury; *Commander Ogden Ludlow*, Navy Dept.; *Howard H. McClure*, Dept. of Commerce (*Maxwell R. Conklin*, alternate); *Blackwell Smith*, WPB; *George A. Viehman*, U. S. Maritime Commission; *Albert Waterston*, Foreign Economic Administration.

The Technical Committee: *V. S. Kolesnikoff*, Bureau of the Budget, Chairman; *Tillman M. Sogge*, Dept. of Commerce, Vice-Chairman; *Louis S. Ballif*, U. S. Tariff Commission; *Captain Arthur J. Beck*, War Dept.; *Maurice H. Blets*, U. S. Tariff Commission; *George G. Brown*, WPB (assigned to the Procurement Division, Dept. of the Treasury); *C. C. Concannon* and *Thomas W. Delahanty*, Dept. of Commerce; *Bruno Fels*, Bureau of the Budget; *Frank Gonet*, U. S. Tariff Commission; *Howard C. Grieves*, WPB; *Esther Pearce*, Bureau of the Budget; *George M. Pollard*, WPB; *Ralph W. Smith*, National Bureau of Standards; *Thomas H. Southard*, WPB.

Special contributions to this project were made by Mr. Louis S. Ballif, U. S. Tariff Commission, Mr. Maxwell R. Conklin, Bureau of the Census; Mr. Howard C. Grieves, WPB; Mr. William R. Leonard, Bureau of the Budget; Mr. Horace B. McCoy, Bureau of Foreign and Domestic Commerce; Mr. James Knox, WPB (assigned to the Procurement Division, Dept. of the Treasury); and Mr. F. A. Mapes, Procurement Division, Dept. of the Treasury, who gave valuable advice and made the necessary administrative arrangements to permit the Technical Committee to function effectively.

[2] *Standard Commodity Classification*, Volume I, "Classified List of Commodities," Technical Paper No. 26, May 1943; Volume II, "Alphabetic Index," Technical Paper No. 27, February 1944, Superintendent of Documents, Washington, D. C.

tures of the United States Commodity Classification System. The absence of satisfactory uniform classification of commodities has always been a matter of deep concern to members of executive and research staffs.

As long as twenty-five years ago, in 1919, a special interagency committee struggled with the glaring inconsistencies and differences in classifications of commodities which prevented getting an account of manufacturing production which could be compared with the accounts of export and import. At that time and later, the Brussels Convention of 1913 on International Commodity Classification, designed primarily to bring some semblance of order in the reports on international trade, could not satisfy immediate needs of the United States because the classification was drafted as a special minimum list of 186 selected items without a definite indication of what these 186 groups should include.

The classification of commodities developed by the Committee of Statistical Experts and accepted by the Council of the League of Nations, September 17, 1935, was also developed as a minimum list for the same purposes as the Brussels classification of 1913. The Committee, in its report, emphasized that the League of Nations minimum list of commodities for international trade should not be considered as a classification system designed to replace any national classification and should serve only as an instrument for comparison of the national export-import reports. Presenting a special listing of 456 selected commodity items and commodity groups, it has never been suggested as a base for development of detailed commodity classification to be used by all branches of business and Government. Finally, in 1939, the United States Central Statistical Board, in its formal report to the Director of the Bureau of the Budget, recommended the development of a standard scheme of commodity classification to supplement the standard industrial code and to put export-import statistics on a comparable basis with production statistics.

So far as the field of commodity statistics is concerned, the great mobilization of the United States production facilities for effective execution of the war program was responsible for the appearance of a substantial number of very important problems. Among these are the need for data on critical and essential materials; development and use of substitutes and entirely new materials; creation and production of new commodities; development of priority and allocation plans; the magnitude of commodity items handled by manufacturers, procurement, and operating war agencies; and the problem of preparing requirements programs, national and international. Attention was called forcefully to the fact that in the midst of war there was no uniform

classification of materials and products. The new problems of reconversion and termination of contracts will bring and are already bringing problems of describing and handling surpluses of raw materials, goods in process, machine tools and equipment.

A United States Senate resolution relating to the problem of postwar *surpluses refers to the "types of commodities."* Types of commodities will have no single definite meaning if they are not established uniformly throughout the whole Federal Government. In turn, types of commodities could not be established without classification and, what is most important, without uniform classification. Uniformity of concept of commodity groups becomes indispensable when condensed reports by groups without any listing of individual items are required. Under these circumstances, we have a very limited choice: it is either uniform classification or chaos. To illustrate the importance and significance of uniform grouping of commodities, in one article published in *Estadística*, the Journal of the Inter American Statistical Institute,[3] it was said:

> The term "aircraft" has sometimes referred to an aggregate of airplanes, helicopters, gliders, airships, and similar vehicles, without equipment; sometimes it has meant an aggregate of such units together with their components such as aircraft engines and propellers; sometimes it has referred to complete units including components, parts of components, and armament equipment; while sometimes it has included such additional items as flight equipment for personnel, aircraft ground equipment, airplane catapults, link trainers, and airplane landing mats. We can see that if no uniformity in the grouping of commodities is established, names of groups do not mean much. The case of "aircraft" is not an exceptional one. In almost every type of commodity we find similar situations in which the precise content of terms used in classification is based either on tradition or on arbitrary decisions. Sometimes differences in definitions are responsible for differences in classification. For example, acceptable practice defines "machine tools" as non-portable, power driven machines that shape metal by progressively removing stock in the form of chips or shavings. But a number of agencies do not know or disregard this definition and include in statistics of machine tools all metal forming machines such as bending, pressing, shearing, punching, and forming machines; other agencies go even further and list as machine tools all machinery generally expected to be found in machine shops such as testing and measuring machines, balancing machines, hoists, and cranes. Uniformity of definition is thus a principal objective of a standard commodity classification.

In June 1941, after appraisal of the existing situation and anticipating war and postwar problems in the handling of surplus property similar to those which developed following World War I, the Assistant Director of the Bureau of the Budget in Charge of Statistical Stand-

[3] *Estadística*, No. 3, V. S. Kolesnikoff, "The United States Project on Standard Commodity Classification."

ards, Dr. Stuart A. Rice, assigned some members of his staff to work on commodity classification. The work resulted in preparing a number of tentative schemes of commodity classification systems, which were submitted to a special interdepartmental conference in December 1941; in drafting a three-digit and then a four-digit commodity code for technical comments of commodity specialists, economists and statisticians; in organizing a special interdepartmental committee, under the Chairmanship of Dr. Rice; and in appointing the Technical Committee, assisted by 40 special committees of experts[4] and charged with the task of developing the United States Standard Commodity Classification.

In the course of preliminary preparations for the interdepartmental conference of 1941, which was called to select a classification system, a suggestion was made that in a standard classified list of commodities a so-called "omnibus code" be used, incorporating several different bases of classification such as (1) use, (2) material, (3) degree of manufacture, (4) origin, (5) producers and consumers, (6) durability, and (7) industry responsible for appearance of the commodity listed, which should occupy fixed positions. It was obvious that incorporation of seven classification codes into one would require even for very broad classification at least fifteen and very likely more digits. This would force prospective users to operate in terms of the omnibus code whether or not its component parts were wanted; in every case of a need for the more detailed classification, the omnibus code would have to be

[4] Complete membership of all committees is given in a published volume of the Standard Commodity Classification. Here it is possible to report only the names of Chairmen of the Special Committees: *J. Mark Albertson*, U. S. Tariff Commission—Nonmetallic Minerals and Ceramic Products; *Serge N. Benson*, U. S. Tariff Commission—Rubber; *Maurice H. Bletz*, U. S. Tariff Commission—Lighting Equipment and Fixtures; *Paul F. Burnham*, U. S. Tariff Commission—Plastic Products; *L. V. Burrows*, WPB—Photographic Goods: *Marshall R. Colberg*, WPB—Aircraft; *Edward J. Detgen*, Bureau of Foreign and Domestic Commerce—Cork; *Joseph M. P. Donohoe*, U. S. Tariff Commission—Lumber; *Meiric K. Dutton*, WPB—Products of Printing and Publishing Industries; *C. J. Enright*, WPB—Ships; *Bruno Fels*, Bureau of the Budget—Nonferrous Metals, Industrial Furnaces; *Walter J. Goehring*, OPA—Valves and Steam Specialties; *Charles Haas*, WPB—Ordnance; *Frederick Harrison*, Bureau of the Census—Railroad Transportation Equipment; *James H. Hibben*, U. S. Tariff Commission—Chemicals, Drugs, Soap and Cosmetics; *Ralph C. Janoschka*, WPB—Paper; *Walter A. Janssen*, Bureau of Foreign and Domestic Commerce—Metallic Ores and Concentrates, Ferro-Alloys; *O. A. Juve*, U. S. Tariff Commission—Agricultural Products, Food, Beverages; *V. S. Kolesnikoff*, Bureau of the Budget—Metalworking Machinery; *Fred B. Lautzenhiser*, WPB—Motor Vehicles; *F. Morton Leonard*, U. S. Tariff Commission—Fabricated Metal Basic Materials; *Charles E. Lund*, Bureau of Foreign and Domestic Commerce—Oils and Fats; *Vincent T. Manas*, Federal Public Housing Authority—Plumbing and Heating Equipment; *William H. Myer*, Bureau of Foreign and Domestic Commerce—General Industrial Machinery and Equipment, Special Industry Machinery; *J. Jos. W. Palmer*, Bureau of Foreign and Domestic Commerce—Products of the Metal Industries; *Donald S. Parris*, Bureau of Foreign and Domestic Commerce—Furniture; *George M. Pollard*, WPB—Iron and Steel; *Charles L. Saunders*, WPB—Instruments; *J. G. Schnitzer*, Bureau of Foreign and Domestic Commerce—Leather and Leather Products; *Sterling F. Smith*, WPB—Air-Conditioning and Refrigerating Equipment; *Tillman M. Sogge*, Bureau of the Census—Miscellaneous Products; *Robert P. Sweeny*, Bureau of Foreign and Domestic Commerce—Textiles; *W. R. Turner*, WPB—Optical Instruments; *Howard E. Way*, Bureau of Foreign and Domestic Commerce—Communication Equipment; *Nicholas Yaworski*, Bureau of the Census—Coal and Coal Products.

reconstructed all over again. Thus, the suggestion was not developed into a definite recommendation.

A second suggestion that died on its way to the interdepartmental conference provided for developing seven or more separate single-principle codes to be used independently when necessary. Co-existence of seven independent codes would be extremely confusing, introducing a possibility that a number of different classifications could be used by various agencies and in consequence defeating the fundamental ideal of uniformity.

Of the commodity classification systems submitted to the interdepartmental conference for a selection, three were considered:

(1) "Vertical" classification according to materials,
(2) "Industrial" classification according to classification of industries responsible for the appearance of commodities listed, and
(3) "Horizontal" classification by stage of production.

A great deal has been, could be, and it is believed will be said for and against each one of these single-principle classification systems.

In favor of the "Vertical" classification, are the facts that the United States Department of Commerce uses a similar system for classification of commodities exported from and imported into the United States, and that the Committee of Statistical Experts of the League of Nations, after prolonged discussions, finally decided to compile its minimum list for international trade on this principle. However, the League of Nations Committee, recognizing that there is no difficulty in classifying crude materials and semi-manufactured on the basis of materials, admitted that the classification falls down when this principle is used in an attempt to classify finished products of manufacturing. Each of such groups of articles as furniture, apparel, musical instruments, communication equipment, would go into different places in the classification system or, after unsuccessful journey all around the list, would finally land in a huge section known as "miscellaneous," or be organized into a special class in violation of the single-principle of the classification. In addition, the vertical system of grouping crude materials and their manufactures, admittedly very convenient for some analytical purposes, would create extreme difficulties for agencies, business organizations and entities specializing in crude materials only or in manufactured products only. Finally, such commodity groups as "manufactures of tin" would not be representative and would therefore remain misleading and meaningless.

The second type, "Industrial" classification, would list all commodities according to the same system as industries responsible for the appearance of such commodities are classified. The difficulty with this

type of classification is that quite frequently the same commodity is a product of two or more industries. The apparent simplicity of this classification is also outweighed by the fact that the industrial structure and therefore the industrial classification might differ from country to country and, as a direct result, classification of industries would never constitute a good base for classification of commodities, and especially for compiling international lists.

The third "Horizontal," single-principle classification, according to the stage of production, keeps crude materials separate from semi-manufactured and manufactured products, and in this respect is very practical and convenient. Nonetheless, this classification would, quite unnecessarily, introduce an extremely difficult technical task of defining the concept of semi-manufactured goods. At the same time it appears that in a very long list of goods, semi-manufactured or manufactured, some additional and entirely different principle would be required for subdivisions.

The conference expressed the opinion that in a classification system it would be advisable to keep crude materials, industrial goods, and finished manufactures in separate sections.

Members of the research staff assigned to the task have been of the opinion that a classified list of commodities should follow the system of their handling by the trade and by operating agencies of the government. One essential fact was recognized, namely, that *the principles of natural classification of materials differ from the principles of classification of products*. When we classify materials (crude, semi-manufactured, or manufactured) used in the process of further manufacturing or in construction, we speak in such terms as hides, fibers, iron, steel, stone, brick, glass, coal, and lumber. When we refer to the end products, i.e., to the articles with process of manufacturing already completed, where there is no room for further manufacturing except assembling operations, the material quite frequently loses its significance or even cannot be traced. It is the article itself we are looking for, associating the idea of the article with the broad idea of use. For us, a chair is not a product of wood, metal, or plastics, but a piece of furniture; the telephone receiving apparatus on our desks always will be associated with the idea of transmittal of conversation or with the broader idea of communication and it would be futile to try to find out what chief material was used in manufacturing this piece of communication equipment; a bathing suit that might be made of cotton, wool, rayon, nylon, glass, or bronze, would never be referred to as a vegetable, animal, metal, or glass product, but always would be identified as a bathing suit, sometimes without any reference to material.

For the construction of a standard list that would provide for the needs of reports on production, on exports, imports, and also the needs of agencies engaged in planning and analysis, and at the same time satisfy the needs of agencies responsible for handling inventories, a single-principle classification would not be as useful as a dual-principle system based on the crude materials, basic materials, and end products concept. In a standard classified list constructed according to a dual-principle system, commodities handled by the Census of Agriculture would be listed separately from commodities covered by the Census of Manufactures or by the Census of Mines; commodities handled by agencies primarily interested in end products would not be mixed with crude materials.

Finally, a new system of classification was submitted to and accepted by the Interagency Committee. This system provided that the Standard Classified List of Commodities, when finally developed and completed, would have the following columns:

Column 1. Numerical code for each commodity item listed;
Column 2. Standard Classified List of Commodities to serve as a master or base list;
Column 3. Standard unit of measure for each commodity item listed;
Column 4. Supplementary single-principle code for classification of commodities according to industries responsible for their appearance;
Column 5. Supplementary code to indicate the economic class of commodities.

It is well to remember that the convenient structure of the Standard Classified List (Column 2) is recognized as a most important feature of the classification system, receiving priority over supplementary single-principle codes to be developed for analytical purposes.

In order to avoid any possible misunderstanding, it is necessary to state that the Interagency Committee on Standard Commodity Classification decided that Columns 1 and 2 should be published immediately; Column 3, either in connection with expanded and revised lists, or in connection with Volume III of *Standard Commodity Classification* which will contain definitions and descriptions; Column 4 and Column 5 to be developed after the war.

Classified list (Column 2) and numerical code (Column 1) require more detailed explanation.

The Standard Classified List of Commodities has three parts.

Part one includes crude materials, namely non-manufactured prod-

ucts of agriculture and mining industries, and other crudes, such as products of hunting, forestry, and fishing. This part embraces major groups beginning with "0" and identified as follows:

01 Live Animals
02 Crude Animal Products, Edible
03 Crude Animal Products, Inedible, Except Fibers
04 Crude Vegetable Products, Edible
05 Crude Vegetable Products, Inedible, Except Fibers
06 Fibers, Vegetable and Animal, Unmanufactured
07 Coal, Crude Petroleum, and Related Crude Hydrocarbons
08 Metallic Ores, Concentrates and Their Unrefined Metallic Products
09 Crude Nonmetallic Minerals, Except Coal and Petroleum

Unfortunately, a detailed description of further subdivisions of major groups in this part as well as in parts 2 and 3 with a total number of classified items more than 35,000, would be too long for inclusion here. The reader is referred to Volume I of *Standard Commodity Classification* described in footnote 2.

Part two includes basic materials or basic industrial goods either semi-manufactured or manufactured, used for further manufacturing, or in process of construction. Predominantly they are not ready for use as such except a few isolated items such as yarns for crochet or wrapping paper. This part includes major groups beginning with "1" and "2" listed in the following order:

11 Leather
12 Boot and Shoe Cut Stock and Shoe Findings
13 Wood Basic Materials, Except Pulpwood
14 Pulp, Paper, and Paperboard
15 Textile Basic Manufactures
16 Food and Beverage Basic Materials
17 Oils, Fats, Waxes, and Derivatives, Animal and Vegetable
18 Petroleum and Coal Products, Except Raw Materials for Chemical Industries
19 Chemicals
21 Iron, and Iron and Steel Scrap
22 Steel
23 Ferro and Nonferrous Additive Alloys
24 Nonferrous Metals
25 Fabricated Metal Basic Products
26 Nonmetallic Mineral Basic Products—Chiefly Structural
27 Nonmetallic Mineral Basic Products—Chiefly Nonstructural
29 Miscellaneous Basic Materials

Part three includes end products of manufacturing industries, previ-

ously explained. They consist of complete articles and also component parts. The following two-digit major groups are included in this part:

31 General Purpose Industrial Machinery and Equipment
32 Electrical Machinery and Apparatus
33 Special Industry Machinery (Machinery for Selected Industries Requiring Specialized Machines)
34 Metalworking Machinery
35 Agricultural Machinery and Implements, Except Tractors
36 Construction, Mining, Excavating and Related Machinery
37 Tractors
38 Office Machines
39 Miscellaneous Machinery
41 Communication Equipment and Electronic Devices
42 Aircraft
43 Ships, Small Watercraft, and Marine Propulsion Machinery
44 Railroad Transportation Equipment
45 Motor Vehicles
49 Miscellaneous Transportation Equipment
51 Plumbing and Heating Equipment
52 Air-Conditioning and Refrigeration Equipment
53 Lighting Fixtures
54 Furniture and Fixtures
55 Photographic Goods and Processed Motion Pictures
56 Optical Instruments and Apparatus
57 Indicating, Recording, and Controlling Instruments and Accessories, Except Watches and Clocks
58 Professional and Scientific Instruments and Apparatus, Except Indicating, Recording, and Controlling
59 Miscellaneous Equipment
61 Food, Manufactured
62 Feed, Manufactured
63 Beverages and Ice
64 Tobacco Manufactures
65 Drugs and Medicines
66 Toiletries, Cosmetics, Soap, and Household Chemical Preparations
67 Apparel, Except Footwear
68 Footwear
69 Fabricated Textile Products, Except Apparel
71 End Products of Leather, Except Apparel, Footwear and Luggage
72 Converted Paper Products and Pulp Goods
73 Products of Printing and Publishing Industries
74 Rubber End Products, Natural and Synthetic, Except Footwear and Clothing
75 End Products of Metal Industries, Except Machinery and Equipment
76 Finished Wood Products, Except Furniture and Millwork

77 End Products of Glass, Clay, and Stone
79 Miscellaneous End Products of Manufacturing Industries
81 Small Arms and Components
82 Artillery, Naval Guns, Mortars, and Components
83 Small Arms, Ammunition and Specifically Adapted Components
84 Artillery, Naval, and Mortar Ammunition and Specifically Adapted Components
85 Aerial Bombs and Specifically Adapted Components
86 Miscellaneous Ammunition and Related Products
87 Common Components of Ammunition
88 Fire Control Equipment
89 Miscellaneous Ordnance and Ordnance Material

One can readily memorize the whole structure by observing that major groups beginning with the integer "3" cover machinery; beginning with "4" cover communication and transportation equipment; "5" cover equipment except machinery and transportation equipment; major groups beginning with "6" cover non-durable consumers goods; beginning with "7" miscellaneous manufacturing; and major groups beginning with "8" cover specialized items of ordnance.

No attempt was made to make each major group strictly homogeneous, for the very simple reason of the limitations of the decimal system. However, the principle of homogeneous grouping was observed in further sub-divisions of major groups into three-digit groups, four-digit groups and all other detailed sub-divisions.

There are a few instances where the content of the major groups could be criticized as inconsistent and therefore violating principles established for the system. For example, in group 638, natural ice is listed as sub-group 6382 next to sub-group 6381, manufactured ice. Purists would rather see natural ice placed with crude materials; however, it was recognized that since there is no difference between the two commodities it would be more desirable to keep all ice in one place.

To meet the needs of agencies which handle not only commodity data but also associated items such as rentals, repair and maintenance, and personal services, it was decided to keep the remaining part of the numerical code beginning with "9" vacant, reserved as part four of the code for supplementary non-commodity items.

A description of the Standard Code would not be complete without reference to the numerical structure of the code selected for the Standard Commodity Classification System. From the very beginning, it was established as a fundamental requirement that the numerical code should be constructed on the decimal system and as such be adaptable for handling records by means of tabulating machines. The numerical

code shown in column I of the Classified List is developed in such a manner that a great number of individual items could be accumulated in a minimum time and with all totals and subtotals readily available. Technical Paper No. 26 describes the decimal system as follows:

> *Throughout the classification* structure the 0 integer has been reserved for *commodity-group titles within* which the integers 1 through 9 will identify specific subtitles. The integer 9 identifies residue groups, and commodities whose codes end in this number usually bear the prefix miscellaneous or the suffix not elsewhere classified. In *instances where one digit did not provide* a sufficient number of integers for identifying the sub-divisions needed within a given category it has been necessary to use two digits, and occasionally three digits. If two digits are used, the code for the group heading ends with 00; the numbers 01–08, 11–18, 21–28, etc., are used and 99 is used for not elsewhere classified. (Note that numbers between 00 and 99 which end with 0 and 9 are not used.) If three digits are used, the code for the group heading ends with 000, and 999 is used for not elsewhere classified.

The Standard Commodity Classification, as it now stands, is designed primarily for general statistical purposes including preparation of program requirements, production reports and reports on international trade. In order to make it available and applicable for inventory control purposes, this classification system should be greatly expanded so as to present not only the classification structure but also to provide for detailed listings of individual items to be identified for inventory purposes.

The Procurement Division of the Treasury Department has already decided to use the Standard Commodity Classification and has begun, in collaboration with the Bureau of the Budget and the committee structure of the Standard Commodity Classification system, to work on extensive expansions of this classification in order to adapt it to the needs of the Procurement Division's surplus property responsibilities.

Since problems faced by the Procurement Division are similar to the problems of other agencies responsible for reports on inventories, it appears very desirable to do the complete job of expansion of the commodity classification for inventory purposes on an interagency basis, pulling together all available resources. Such combination of efforts is indispensable because it is a big job far beyond the facilities of one department.

PHYSICAL MEASUREMENTS OF MOUNT HOLYOKE COLLEGE FRESHMEN IN 1918 AND 1943

BY MARION GILLIM*
Mount Holyoke College

IT IS WIDELY believed that the American soldier of World War II is taller, heavier and stronger than his counterpart of World War I. Morris Fishbein wrote in December 1941:

> Available figures indicate that physical examinations made of selectees of the National Guard, the "volunteers," the regular army and even the young men examined for the CCC and NYA show an increase in height and weight over young men of the same ages examined in 1917.[1]

Interest in the question whether the young women of today are also stronger and larger than those of twenty-five years ago led the class in elementary statistics of the Department of Economics and Sociology at Mount Holyoke College to make a comparative study of physical measurements of freshmen entering the college in 1918 and 1943.

The study employs the physical records of 250 freshmen of 1918 and 308 freshmen of 1943. The measurements used are those of height, weight, lung capacity and the grip of the right and left hands. Height was measured to the nearest tenth of a centimeter. The use in 1943 of a wall stadiometer instead of the free-standing wooden stadiometer of 1918 probably does not injure the comparability of the measurements of height made in the two years. Although in 1918 lung capacity was measured to the nearest cubic inch by an older model double pulley spirometer and in 1943 to the nearest tenth of a liter by a new and more accurate single pulley spirometer, the data are considered comparable.[2] Weight was recorded to the nearest quarter of a pound. A regulation garment, weighing approximately one-half pound, was worn in both years. The weight of the robe was deducted from the recorded weight in 1918 but not in 1943. The arithmetic mean of the weights in 1943 has been corrected for this difference in the method of recording. The same type of device was employed in both years to measure grip to the nearest kilogram.

The examinations for both classes were in September of the year of entrance, and were scheduled throughout the mornings and afternoons. The measurements were made by the members of the Department of

* The author acknowledges the assistance of Miss Shirley Garfield and Miss Margaret Welch.

1 Morris Fishbein, "American and German Standards of Physical Fitness," *Hygeia*, December 1941, p. 953.

2 The present spirometer is blown easily, and therefore is less likely to underestimate lung capacity than some other spirometers. (Abby H. Turner, "Vital Capacity in College Women: I," p. 3, Reprinted from the *Archives of Internal Medicine*, Vol. 46, 1930, pp. 930–937.)

Physical Education which has maintained sufficient continuity of personnel to assure uniformity in technique. To facilitate computations, the data were transcribed to cards by the members of the class in statistics. The arithmetic means and standard deviations, as calculated from a frequency distribution of each measurement, are shown in Table I for both 1918 and 1943.

TABLE I

ARITHMETIC MEANS AND STANDARD DEVIATIONS OF PHYSICAL MEASUREMENTS OF 250 FRESHMEN IN 1918 AND 308 FRESHMEN IN 1943 AT MOUNT HOLYOKE COLLEGE

Measurement	Arithmetic mean		Standard deviation	
	1918	1943	1918	1943
Height (centimeters)	161.7	164.8	6.3	5.9
Weight (pounds)	118.4*	128.0*	16.6	17.2
Lung capacity (liters)	2.6	3.2	.41	.47
Right grip (kilograms)	30.2	31.7	5.0	5.7
Left grip (kilograms)	28.7	29.5	4.4	5.4
Stronger grip (kilograms)	30.9	32.3	4.6	5.4

* Exclusive of garment weighing one-half pound.

For each measurement the arithmetic mean of 1943 exceeds that of 1918. There is clear indication of the greater size and strength of the later group.[3] Except for left grip, the differences between the two years are too great to be attributed to chance.[4] The failure of left grip to increase as significantly as right grip suggests that exercise may have

[3] Similar findings have been reported in other studies of college students in earlier periods. One was made by Mabel Newcomer in 1921 of the changes in physical measurements—including height, weight and lung capacity—of Vassar College freshmen from 1884 to 1920 inclusive. Within that period the average of all these measures increased. Between 1890 and 1920 height, as described by the arithmetic mean, increased by 3.3 centimeters or 1.3 inches, from 160.4 centimeters to 163.7 centimeters. The mean weight increased six and one half pounds from 118.2 pounds in 1891–95 to 124.7 pounds in 1916–20. A lack of regularity in the growth of lung capacity was attributed to the changes in the types of spirometers and to defects in these instruments. The mean age of the students had declined from 19.0 years in 1891–95 to 18.2 years in 1916–20. (Mabel Newcomer, "Physical Development of Vassar College Students, 1884–1920," this JOURNAL, Vol. XVII, 1921, pp. 976–982.)

Another study of physical development, made by Gordon Bowles in 1932, includes a comparison of the heights and weights of mothers and daughters from Wellesley, Vassar, Smith, and Mount Holyoke. The mean height of the daughters was 2.93 centimeters greater than that of their mothers, and their mean weight exceeded that of their mothers by four pounds. The average age of the mothers at the time of measurement was 18.76 years, while the average age of the daughters was 17.88 years. (Gordon Bowles, *New Types of Old Americans at Harvard and at Eastern Women's Colleges*, Harvard University Press, Cambridge, 1932, pp. 95–133.)

[4] The significance of the difference between the two means was tested as follows:

The standard error of the difference between the two means was computed by the formula:

$$\sigma\bar{X}_1 - \bar{X}_2 = \sqrt{\frac{\sigma_1^2}{N_1 - 1} + \frac{\sigma_2^2}{N_2 - 1}}.$$

The difference between the two means, expressed in terms of the standard error of the difference between the two means, was interpreted as a normal deviate.

A one per cent level of significance was used.

developed the right hand more than the left for right-handed girls. To compensate for left-handedness the arithmetic mean of the stronger grip was computed also. Although the difference between the means of stronger grip is slightly less than the difference between the means of right grip, the difference is as significant because of the greater uniformity in stronger grip in each year.

The freshmen entering in 1943 were younger than those entering in 1918. The average age of the 250 girls in 1918 was 18.4 years while the average age of the 308 girls in 1943 was 17.9 years. A negligible correlation between age and each of the four measurements in both years is indicated by the small values of the coefficient of correlation shown in Table II. The coefficient of correlation differs significantly from zero

TABLE II

CORRELATION BETWEEN AGE AND FOUR MEASUREMENTS FOR 250 FRESHMEN IN 1918 AND 308 FRESHMEN IN 1943 AT MOUNT HOLYOKE COLLEGE

Measurement	Coefficient of correlation	
	1918	1943
Age and weight	−.114	+.035
Age and height	−.060	−.044
Age and lung capacity	+.055	−.008
Age and stronger grip	−.095	+.176

only in the correlation[5] between age and stronger grip for 1943. The lack of significant correlation with age in every case except that of stronger grip in 1943, and the positive correlation in that case, indicate that the increase in size and strength cannot be explained by the difference in age.

The distribution of freshmen by birthplace in Table III shows a different representation of geographical regions within the two classes. The most important change is the decreased percentage coming from New England and the increased percentage from the Middle Atlantic States. In order to discover whether this shift in geographical origin could account for the greater size and strength of the 1943 freshmen, the measurements of the freshmen born in New England were treated separately. The arithmetic means and standard deviations, shown in

[5] The significance of the difference between r and zero was determined as follows:
The standard error of r was determined by the formula:

$$\sqrt{N-1}$$

The difference between r and zero was expressed in terms of the standard error of r and treated as a normal deviate.
A five per cent level of significance was used.

TABLE III

GEOGRAPHICAL DISTRIBUTION OF FRESHMEN ENTERING MOUNT HOLYOKE IN 1918 AND 1943

Birthplace	1918		1943	
	Number	Per cent	Number	Per cent
New England	109	43.6	91	29.5
Middle Atlantic	93	37.2	139	45.1
Other regions of the United States	37	14.8	59	19.2
Foreign	6	2.4	14	4.6
Not recorded	5	2.0	5	1.6
Total	250	100.0	308	100.0

Table IV, were calculated from frequency distributions of each measurement of the 109 New England freshmen of 1918 and the 91 New England freshmen of 1943. The arithmetic mean of each measurement of the New England freshmen of 1943 exceeds[6] that of the New England freshmen of 1918. It is unlikely, therefore, that geographical changes could have explained the differences shown in Table I.

TABLE IV

ARITHMETIC MEANS AND STANDARD DEVIATIONS OF PHYSICAL MEASUREMENTS OF 109 NEW ENGLAND FRESHMEN IN 1918 AND 91 NEW ENGLAND FRESHMEN IN 1943 AT MOUNT HOLYOKE COLLEGE

Measurement	Arithmetic mean		Standard deviation	
	1918	1943	1918	1943
Height (centimeters)	162.3	164.2	6.2	5.7
Weight (pounds)	117.5*	126.7*	14.5	16.1
Lung capacity (liters)	2.6	3.2	.42	.47
Right grip (kilograms)	29.7	32.1	4.9	5.3
Left grip (kilograms)	28.5	29.8	4.8	5.1
Stronger grip (kilograms)	30.5	32.6	4.4	5.2

* Exclusive of garment weighing one-half pound.

In the absence of any indication that the true explanation of the increased measurements is based on age or geographical origin, the answer must be sought elsewhere. Possible contributing factors, beyond the scope of this study, are better nutrition, better infant care, less restrictive clothing for women, increased participation on the part of more students in physical activity and greater interest in physical fitness.

[6] The differences are significant for all but height and left grip when a one per cent level of significance is used. The difference in height is significant with a five per cent level of significance. Left grip shows a less significant difference.

APPRAISAL OF THE U. S. BUREAU OF LABOR STATISTICS COST OF LIVING INDEX: APPENDIX*

PREPARED FOR A SPECIAL COMMITTEE OF THE AMERICAN STATISTICAL ASSOCIATION†

OUTLINE

* For the Report itself see this JOURNAL, December 1943, pp. 387–405. Because of the urgency of the task confronting the Committee and the limited availability of data and statistical facilities, the Appendix is not so full or balanced as would be desired. It is felt, however, that the material collected here will contribute to an understanding of the scope of the Bureau's cost of living index and to a critical appreciation of its accuracy.

† By Dorothy S. Brady, Bureau of Human Nutrition and Home Economics, and Solomon Fabricant, National Bureau of Economic Research, with the assistance of the staff of the U. S. Bureau of Labor Statistics.

GENERAL DESCRIPTION OF THE INDEX

Definition. The cost of living index prepared by the Bureau of Labor Statistics is an answer to the question, "How much has the cost of living changed?" This question as stated is not specific and before an index can be computed, a precise definition of the term "cost of living" is needed. Thus, families do not live at the same income level each year; some receive additional income, others have less. If the question "How much has the cost of living changed?" is defined to mean how much have living costs changed when only the effect of changes in prices is considered, then changes introduced by variations in income are ruled out. The Bureau of Labor Statistics has arrived at the procedures used in computing its cost of living index by assuming that the question of "how much living costs have changed" can be answered by measuring the changes which would have occurred in a family's cost of living if it had purchased the same goods and services in two periods. The index then is a measure of the changes in the cost of a bill of goods and services consisting of identical quantities and similar qualities in any two successive periods in given amounts. This is not the only possible definition that could be adopted. It is, however, the one most widely used for indexes of this type and the most suitable for practical computation, given the present collections of data on consumer behavior and our knowledge of economic laws.

Population groups represented. The index of the cost of living computed by the Bureau of Labor Statistics measures the changes in the cost of goods and services purchased by specific groups in the population described as families of "wage earners and lower-salaried clerical workers in large cities." The commodities and services included in the index, their weights and specifications, the cities covered, and the sample of stores within cities were all selected with recognition of this restriction in population coverage. The index does not purport to be representative of other groups in the population, such as single individuals, however employed, families of business and professional men, or families living on pensions or relief allowances, nor does it take account of changes in the cost of living of families migrating to large cities from rural communities or from other cities.

Formula. The cost of living index is based on the formula of Laspeyres:

$$R_i = \frac{\sum q_o P_i}{\sum q_o P_o} \cdot \tag{1}$$

Where the q_o are the average quantities of each item used by the

families in the wage earner and clerical group in the base period, the P_o are the prices for these items in the base period and the P_i the prices for the ith period. A measure of the quantities q_o was determined from an expenditure study in the initial period and the P_i's are obtained by a collection of prices during each period for which the index is computed.

In practice the index is calculated from the formula:

$$R_i = R_{i-1} \frac{\sum q_o P_{i-1} \cdot \frac{P_i}{P_{i-1}}}{\sum q_o P_{i-1}} \tag{2}$$

which is equivalent to (1). In this form the index is expressed as a weighted average of the price relatives for each commodity, the weights being the "cost" $q_o P_{i-1}$, in the previous period. The product of this average and the index for the previous period gives the value of the index for the given period. The weights, $q_o P_{i-1}$, used in calculation are called the "cost weights" and change from period to period with changes in prices. The index as calculated may be expressed most simply as

$$R_i = R_{i-1} \sum e_{i-1} r_i \tag{3}$$

where e_i is the cost weight expressed as a proportion of the total costs and r_i the price relative for a given commodity or service and R_i is the index for the ith period.

Precision of measurement both in the weights and in the prices is of importance, but in general an index is affected less by errors in the weights than by errors in the prices. Errors in the weights as expressed in formula (3) must be both positive and negative with a sum of zero,[1] whereas errors in the prices may all be in one direction. The movement of the index may, however, be significantly influenced by changes in the weights for particular items if such changes are associated with the price changes.

Selection of weights. The weights for the commodities and services in the present index were derived from studies of the expenditures of wage earners and clerical workers made in 1934–36, described below. From the 578 items of family expenditures recorded separately on the schedule, 198 were selected for the index on the basis of two criteria: (1) importance in the family budget, and (2) correlation in the price movements of related commodities.

[1] Weights represent a distribution of the importance of each item usually in percentage terms totalling 100. Understatements in any one item, therefore, must be offset by overstatements in another.

For each item selected for the index, the expenditure weight was determined by adding together the average expenditures for the article itself, the average expenditures for similar items known to have the same price movement, and the proportionate share of the miscellaneous expenditures of the same consumption group. For example, the expenditure weight for studio couches was the average expenditure for studio couches, other couches, day beds, and davenports; a relative part of expenditures for miscellaneous furniture; and a relative part of the expenditure for articles of housefurnishings itemized on the survey schedule as "other housefurnishings expense."

The method of allocating the weights to the items included in the index is explained in detail in the Bureau of Labor Statistics Bulletin No. 699: *Changes in Cost of Living in Large Cities in the United States, 1913–41*. The details for the food group, for example, are given in Table 6 of that Bulletin and those for clothing in Table 10.

Development of specifications. In order to standardize its measurement of price changes, the Bureau has developed descriptions or "specifications" for most items in the index. Each specification represents, in the opinion of commodity experts and specialists in industry and the various trades, the article most frequently purchased in the price lines in which wage earners and clerical workers were concentrating their purchases in 1934–36. Each article is described in terms used in the trade, and details of construction are given in order that the article may be readily identified. For clothing, the fabric, stitching, size ranges, style, and other features are stated. For furniture, the kind of wood, finish, construction, metal fixtures, and other details are fully described.

Since these descriptions are designed primarily for the collection of prices on the same qualities in many cities from time to time, some range in construction details is allowed in order that prices may be obtained on goods sold in different parts of the country. Thus, although the specifications are detailed, more than one type, quality, or price level may satisfy a given specification. In the usual practice, the quality satisfying the specification and selling in largest volume is selected in each outlet giving price information, and this choice is followed throughout the period during which the particular specification is used for that outlet.

Because of changes in manufacturing processes, kinds of materials available, style, etc., certain specifications become outmoded, the length of the period for which they are valid varying for the different groups of merchandise. The specifications for such articles as winter clothing need to be modified about every two years in normal times, and in wartime even more frequently. The new specification is made to

adhere as closely as possible to the one used in the previous periods in respect to such fundamental characteristics as materials and design.

Cities included in the sample. The national cost of living index representing large cities is based on price data collected in three samples of cities most of which are over 100,000 population. For each quarterly period (March, June, September, and December) the index is calculated by combining the national food-cost index, which is based on changes in food prices in 56 cities, and the indexes of prices of other important goods and services in 34 out of the 56 cities. For the other 8 months of the year the index is calculated on the basis of food prices in 56 cities and the prices of an abbreviated list of other commodities and services in 21 of the 34 cities. This monthly index was begun in 1940.

Collection and number of prices. Prices for the items chosen for the index and described by the specifications are collected by agents of the Bureau from a sample group of the stores in each city included in the index.

The goods and services priced for the index are selected to represent the typical purchases of wage earners' families. They are changed as required by normal market developments as well as by wartime conditions. In June 1943 the total list of articles had been reduced from the 198 included, on the basis of the family expenditures survey in 1934–36, to 183. This total list of 183 items included prices of 59 foods, 43 articles of clothing, 12 kinds of fuel, 23 kinds of housefurnishings, and 46 miscellaneous goods and services. Two or more qualities are priced for most articles of clothing and housefurnishings and for some of the commodities in the other groups. Altogether, therefore, prices of 342 different articles and qualities are obtained for the official cost of living index in each city. For the inter-quarterly monthly indexes a somewhat smaller number of articles is priced.

Foods: Food prices for the food-cost index are obtained for all staple foods, such as bread, butter, potatoes, etc., in 56 cities. They are obtained in these cities from 1,129 independent grocery stores and markets, 208 chain organizations, 152 dairies, and 340 bakeries. The 208 chains represent 8,640 stores, making a total of 10,261 outlets represented.

Clothing: The clothing priced represents those items usually purchased by city wage earners' families, including men's suits, work clothing and shirts, and women's dresses, hose, coats, shoes and various accessories. Clothing for infants and most articles for boys and girls are not included.

Housefurnishings: Living room and dining room suites, mattresses, bed springs, stoves, washing machines, sheets, glassware, etc., represent the furniture and furnishings which are priced for this group in the index. It is in this group of articles that most changes have occurred since the beginning of the war period.

Fuel, electricity and ice: As indicated above, 12 different kinds of fuels

are priced. Special emphasis is placed on those fuels which are of importance in each locality. Typical bills for gas and electricity are computed from the rate schedules obtained from utilities in the large cities.

Miscellaneous goods and services: A large variety of goods and services purchased by the average family in the wage-earner and clerical group is priced. These include such diverse commodities as drugs, automobiles, and tires; and such services as medical and dental care, and hair cuts.

Rents: Since September 1942 rents have been gathered directly from tenants. More than 1,500 dwelling units are surveyed in a typical large city every quarter. Prior to the middle of 1942 rents had been based upon reports for identical dwelling units, obtained from rental management agencies.

Altogether, more than 145,000 price quotations are obtained for calculating the cost-of-living index each quarter.

As noted, since the outbreak of the war many articles have, of necessity, been dropped from the list and others have been added. Most important of those dropped were automobiles and tires, electric refrigerators and other durable household equipment, and certain textile products—notably silk hose. Substitutes for some of these were added, such as wartime models of furniture, and rayon hose. Some foods, such as hamburger, liver, and rolled oats, have been added because of their wartime significance.

APPRAISAL OF THE METHODS OF OBTAINING PRICES AND PRICE RELATIVES

Selection of the sample of outlets. Since the index measures the trend of prices of goods purchased by wage earners and lower-salaried clerical workers, the stores selected for the sample are taken as representative of the outlets patronized by such families. For the collection of food prices independent outlets are chosen from districts in the city proper (not including suburbs) where the residents are chiefly wage earners and lower-salaried clerical workers. Such districts are selected on the basis of local information relating to general rent level, location of plants and factories, and the concentration of racial groups. The individual food stores in the sample are chosen so that the number from each sales-volume group is proportional to the total sales of that group. As shown by data of the Bureau of the Census, the sales-volume groups are as follows: sales of less than $20,000 per year; $20,000 and under $50,000; $50,000 and under $250,000; and $250,000 and over.

Retail food prices are collected from the same stores at each pricing period. When a store is dropped from the sample for any reason, a replacement having the same type of operation is chosen from the same neighborhood and the same sales-volume group.

All important grocery chains within the corporate limits of the city

are included in the sample, and if more than one type of store is operated by a particular chain, prices are secured from each type having different selling prices. The prices from chain and independent stores are combined by use of weights, based on the total sales for the two types of organization as reported by the Bureau of the Census and the BLS-OPA "Food Margin" Survey of 1942. Prices from the individual corporate chain organizations are weighted according to each organization's annual sales in each city as reported by each firm to the Bureau.

The outlets from which retail prices of other goods have been priced have been selected on the basis of size and kind of outlet, type of operation, quality of commodities sold or services rendered, and location and clientele. Both department and specialty stores are included in the store samples, as well as national, sectional, and local chains, and independent stores. Outlets selling commodities or rendering services on a cash and carry basis are represented as well as those granting regular credit and delivery service or installment credit. Stores operated by mail-order houses are included in the Bureau's sample in those cities where they are situated.

For each article other than food, price quotations are obtained from at least 5 stores in New York City and at least 4 stores in other cities. Some stores visited supply prices for just one article, others for several articles, but only a few stores are able to give prices for all of the articles in a commodity grouping as described by the specifications. Thus, in most cities it is necessary to visit 10 or more stores in order to obtain at least four quotations for each article priced in the clothing group.

General description of the method of pricing. Most of the prices used in the calculation of the Bureau of Labor Statistics cost of living index are obtained by trained representatives through personal interviews with store managers or buyers. As a rule, the only data not obtained by personal call are prices of household fuels and rates for electricity and gas. Retail fuel prices are reported on questionnaires mailed directly to the dealers, and all data on rates for electric current are obtained from the Federal Power Commission. Gas rates are obtained from the utility companies by mail.

In stores where prices are regularly posted in full view of the customers, the representative obtains price data by personal inspection of the posted prices and checks these with proprietors or managers. If prices are not posted, the representative fills out the schedule by questioning the manager. Whenever possible, merchandise and price tags are examined.

In the collection of prices of foods as well as of other commodities, in order to maintain comparability each representative is provided with

a set of records which gives the brand, lot number, or grade (where it is available) and other identifying information relative to the prices obtained during previous months, as well as the general "specifications" described above. If the same brand or quality is no longer available, the representative substitutes a new one and obtains the previous period's price for the substitute. By having prices for earlier months readily available, the representative can determine whether the substituted item was of the same general price level in the previous month as the item no longer stocked by the reporting store.

All data for the cost of living index are published as referring to the middle of the month. Food prices are collected each month and apply to the Tuesday nearest the fifteenth; collection may, however, be made on the preceding Monday or the following Wednesday. Collections of data for items other than food are usually made in the two weeks preceding or the week following the date to which the index applies. For the monthly index, an abbreviated list of commodities and services is priced. The full list is priced at three-month intervals.

Variability of prices among outlets. The Bureau has not in the past calculated measures of the dispersion of prices among outlets on the basis of which the sampling errors of the average prices and of the price relatives could be estimated. In March 1943, the Bureau began to include in its monthly release "Retail Food Prices by Cities," the ranges of food prices (that is, the highest and lowest prices reported for each food) in all of the cities included in the food-cost index. These published data are not adequate, however, for computing statistical measures of variability. The calculation of the standard deviations of the prices of a few selected foods in Detroit indicates that the standard errors of the average prices for the foods, when based on 15 to 20 quotations, are all probably less than 1 cent and most are less than half of a cent.

To judge whether the Bureau's sample of stores is representative of those where wage earners buy and to evaluate the accuracy of the regular price reports, the Committee developed three special tests described in the following section.

Special tests of the price reports. (1) **Additional samples of stores.** In June 1943 the Bureau of Labor Statistics, at the request of this Committee, conducted experimental tests designed to provide some information that would lead to an evaluation of the price data collected. In the first of these tests, a sample of independent food stores (within the corporate limits of the city), in addition to the Bureau's regular sample, was chosen in accordance with criteria set by the Committee staff. The prices of foods were obtained in the same way and on the same day that the Bureau of Labor Statistics representatives obtained

the prices for the regular sample. This test was conducted in 6 cities: Washington, Detroit, Milwaukee, Atlanta, San Francisco, and Scranton. A second additional sample of stores was chosen from the suburbs of 4 of the cities: Washington, Detroit, San Francisco, and Milwaukee. In July, price reports were obtained from the stores included in the additional samples in Washington, Detroit, and San Francisco.

In choosing the stores for this test, the recent Census publications giving block statistics for cities of 50,000 or more population made it possible to delineate the districts to be sampled more directly and objectively than was possible when the regular samples of reporting stores were chosen. Areas in which the average rent or rental value of dwellings in each block was not less than $15 and not more than $50 were considered districts in which wage earners and lower-salaried clerical families live. The selection of this range of average rent was based on the distribution of rents paid by wage earners and lower-salaried clerical workers included in the sample of urban families surveyed in the 1941 expenditure study.[2]

In the suburbs a similar sample was chosen to test whether the level of prices there differed significantly from that in the city proper, to which the Bureau reports are limited. Here an additional criterion was used in defining the districts to be included in the sample. The commuting fare in the districts chosen was restricted to not more than twice the fare on public transportation within the city limits.

All food stores on streets within the districts selected were listed and from these lists every *n*th store was selected, *n* being determined so as to yield the same number of stores as are in the regular sample.

Most of the differences between the averages from the additional samples and those from the regular sample were less than 5 per cent but there was a majority of cases in which the averages from the regular sample exceeded those from the additional samples. The suburban samples differed no more from the regular sample than did the additional sample within the city limits. If the differences between the two samples within the city limits can be explained, it may be concluded that the regular sample is representative of the level of prices in the whole metropolitan area in which the wage-earner families live and buy their food.

Weighted aggregates of the prices reported in the additional samples were below the corresponding aggregates of the regular sample in 5 of the 6 cities. The difference averaged 1.7 per cent. The smallest discrepancy (0.6 per cent) was in Milwaukee where, as exception to the gen-

[2] Bureau of Labor Statistics Bulletin No. 724: *Spending and Saving of City Families in Wartime.*

eral rule, food costs averaged somewhat higher in the additional stores than in the Bureau's regularly reporting stores. Prices in the additional sample within the city limits were 1.5 per cent below the prices in the regular sample in Detroit; 2.0 per cent in San Francisco; 2.1 per cent in Washington and Scranton; and 4.8 per cent in Atlanta. This repetition of similar discrepancies in five out of six cities would not be expected on the basis of sampling alone. It is therefore necessary to conclude that the regular samples and the additional samples differed systematically in some respect.

TABLE I

FOOD COSTS IN ADDITIONAL SAMPLE IN 6 CITIES RELATIVE TO FOOD COSTS IN REGULAR BLS SAMPLES, JUNE 1943

Price from regular BLS sample in city proper = 100
(Based on additional samples of prices in stores within city limits)

Commodity	Detroit	Milwaukee	San Francisco	Washington, D. C.	Atlanta	Scranton	Average of 6 cities
All foods	98.5	100.6	98.0	97.9	95.2	97.9	98.3
Cereals and bakery products	98.4	100.9	98.6	99.5	101.4	98.1	99.1
Meats	97.1	99.3	97.8	95.6	88.2	94.7	96.2
Dairy products	101.0	100.2	100.8	99.8	101.7	99.7	100.7
Eggs	97.9	100.6	99.0	98.6	94.9	96.7	98.3
Fruit and vegetables	98.3	101.6	95.6	98.7	96.5	99.4	98.0
Fresh fruit and vegetables	98.9	101.7	94.7	98.9	96.2	100.1	98.2
Canned fruit and vegetables	94.4	100.7	102.3	98.0	94.9	94.7	97.2
Dried fruit and vegetables	93.0	100.0	100.5	97.8	106.9	99.3	97.0
Beverages	98.9	104.6	100.6	100.5	94.3	97.8	99.6
Fats and oils	98.1	99.9	99.1	95.9	96.4	100.2	98.0
Sugar and sweets	98.7	101.0	100.6	97.3	98.2	99.3	99.1

Note: Weighted aggregates were calculated by multiplying the average price for each commodity in the additional sample by the revised (March, 1943) consumption weights for commodity in each city and showing them relative to the Bureau's averages for its regular sample as 100. The few commodities for which fewer than five quotations were available in either sample were not included in the comparison.

Two possibilities must be considered to explain a systematic difference between the samples: First, that the regular samples yield an overestimate of the average prices of the commodities reported; and second, that the additional samples gave underestimates of the prices of foods, individually and in the aggregate. The first of these explanations implies either that the stores in the regular sample include a disproportionate number with relatively high prices or that a tendency has developed for the stores to report on lines of foods with higher prices than the average for the specification ranges. The latter hypothesis can be verified to some extent by a study of the brand distribution of the price reports for the canned and packaged foods.

The stores reporting to the Bureau in each of the samples were asked to give prices for the "best-selling" brands. In the regular sample the brands reported as "best-selling" over a period of time tend to be mainly those having a wide national or regional distribution. In a given month, particularly in a time of shortages, packers' label brands may be more widely sold by retailers as was indicated by a large proportion of stores in the additional samples reporting prices on such brands. When the average prices of a few foods were tabulated by brand, the additional samples and the regular sample were in close agreement. For example, the average price of a nationally advertised

TABLE II

FOOD COSTS IN SUBURBAN SAMPLES IN 4 CITIES RELATIVE TO FOOD COSTS IN REGULAR BLS SAMPLES, JUNE 1943

Price from regular BLS sample in city proper = 100
(Based on additional samples of prices in stores in suburban areas)

Commodity	Detroit	Milwaukee	San Francisco	Washington, D. C.	Average of 4 cities
All foods	97.2	100.8	98.8	99.0	98.3
Cereals and bakery products	98.2	101.2	96.0	98.9	98.1
Meats	96.1	97.6	98.9	97.6	97.2
Dairy products	100.5	100.6	102.1	100.2	100.8
Eggs	97.7	100.6	99.6	102.5	99.3
Fruit and vegetables	94.9	103.5	97.3	99.7	97.3
Fresh fruit and vegetables	94.9	103.6	97.1	99.8	97.2
Canned fruit and vegetables	95.2	101.4	100.1	99.5	97.9
Dried fruit and vegetables	95.5	104.2	94.0	98.0	96.5
Beverages	99.2	107.0	100.2	101.1	100.7
Fats and oils	97.4	100.6	101.7	98.0	98.7
Sugar and sweets	99.3	99.8	102.0	96.6	99.6

Note: Weighted aggregates were calculated by multiplying the average price for each additional sample by the revised (March, 1943) consumption weights for each city and showing them relative to the Bureau's averages for its regular sample as 100. The few commodities for which less than five quotations were available in any sample were not included in the comparison.

brand of macaroni in the Detroit regular sample was 20.1 cents; in the additional sample within the city limits 19.4 cents and in the suburban sample 19.2 cents. Nearly all of the reports in the regular sample were for this brand, while more than half of the stores in the additional samples reported other and less expensive brands. As a result the average price for all brands in the regular sample amounted to 19.4 cents, and to 14.8 cents in the two additional samples.

It thus appears quite probable that in the case of the canned and packaged foods, the difference between the regular and the additional samples was in the distribution of the reports among the different brands. Only a comprehensive study of the volume of sales of each food defined by the specification would give the basis for judging whether

the regular sample yields a representative distribution among brands over a period of time. It is apparent from the example given above that in a given month this distribution may be quite unrepresentative of the brands on grocers' shelves. An interesting problem is raised by these considerations: Should the distribution of price reports each month conform to the particular frequencies existing at that time? If so, not only the price reporting but also the calculation of price changes would be made much more complicated and expensive. If, on the contrary, it is considered theoretically desirable to achieve a distribution that is representative of the sales by brands over a longer period, such as 6 months or a year, then it may be expected that any new sample in times like the present would differ from the regular sample as in this experiment.

The differences between the regular and the additional samples were not limited to the canned and packaged foods. In most of the meats and in some of the fresh vegetables and fruits also, the average prices reported by the stores in the regular sample were higher than the average prices in the stores in the additional samples. For these foods it is reasonable to assume that in the additional samples there were few or no prices reported above ceiling prices. As noted elsewhere, the stores in the regular sample report prices above the established ceilings sufficiently often to raise the average price as much as the differences under consideration. Since the owners or managers of the stores in the additional samples could easily have misunderstood the nature and purpose of the inquiry on the part of Government representatives with whom they had had no previous acquaintance, it is not unlikely that in most cases the prices reported were less than or equal to the ceiling price.

The chief function of the collection of retail prices is to measure the price changes over a period of time. Therefore, a comparison of the results from the additional samples in the three cities where the data were collected in both June and July offers the most significant test of the city samples. An index of the change in food costs was calculated, using exactly the same procedures for each of the three samples. The decrease during this period resulted from the seasonal decline in fresh fruits and vegetables and a lowering of some ceiling prices by the Office of Price Administration.

	Change in the Cost of Foods from June to July 1943 in		
	Detroit	*San Francisco*	*Washington, D.C.*
Regular sample	−1.7	−4.4	−1.4
Additional samples:			
City proper	−1.5	−3.7	−3.4
Suburbs	−0.7	−4.3	−1.8

The differences between the regular sample and the additional sample within the city proper for San Francisco and Washington suggest a margin of variation larger than is desirable in the index series even though they can, by means of statistical tests, be attributed to sampling fluctuations. The question, therefore, arises whether the number of stores in these samples is large enough to yield a measure of relative change in price that would not, in general, vary as much from sample to sample. The price changes for separate foods in the three samples were in general agreement when they were based on 20 or more quotations. Over half of the changes for the three samples, however, had to be measured from a smaller number of reports. Less than 10 quotations in the Detroit suburban and Washington additional city sample were obtained for more than one-third of the foods (Table III). Even though

TABLE III

DISTRIBUTION OF FOOD PRICES COLLECTED IN 3 CITIES, BY NUMBER OF QUOTATIONS SECURED FOR EACH FOOD, IN THE BLS REGULAR SAMPLE AND IN TWO ADDITIONAL SAMPLES—JUNE 15 AND JULY 15, 1943

City and sample	Number of foods for which the following number of quotations were obtained					
	Less than 5 quotations	5–9 quotations	10–14 quotations	15–19 quotations	20–30 quotations	Total quotations
Detroit:						
Regular sample	6	5	11	15	20	57
Additional sample (city)	8	17	12	7	12	56
Additional sample (suburbs)	18	3	12	10	14	57
San Francisco:						
Regular sample	4	4	7	20	25	60
Additional sample (city)	6	14	3	5	31	59
Additional sample (suburbs)	6	13	6	2	32	59
Washington, D.C.:						
Regular sample	5	5	4	11	36	61
Additional sample (city)	10	12	3	5	31	61
Additional sample (suburbs)	7	5	12	2	35	61

the weight of a single food is small, the composite effect of a large sampling error in a substantial number of price relatives can apparently lead to a large variation in the weighted aggregate. At the present time, the prevalence of shortages has intensified this problem. It thus appears that in order to keep at a minimum the variation in the measure of relative price change in individual cities, it may be necessary for the Bureau of Labor Statistics to add temporarily to its sample of independent stores. It should be noted, however, that the measure of price change in independent stores forms only part of the total estimate of

change. If the change is more accurately measured for chain stores, the error is obviously less than indicated in this comparison.

(2) Prices from chain-store outlets. The Bureau regularly collects chain-store food prices from district or local headquarters of the predominant chains in each city or from a single store designated by the headquarters. The various chains consented to a test in which the prices reported by central offices were checked against the actual prices being charged in a sample of the chain outlets in the city. This test was to ascertain whether the prices charged in the individual chain outlets center around the approximate price scale established by the chain headquarters. In all 6 cities, 78 per cent of the prices reported by the individual outlets were the same as the prices reported by the chain

TABLE IV

DISTRIBUTION OF INDIVIDUAL CHAIN STORE PRICES IN RELATION TO PRICES REPORTED BY CHAIN HEADQUARTERS AND PERCENTAGE DIFFERENCE BETWEEN FOOD COST AGGREGATES BASED ON AVERAGES OF INDIVIDUAL STORE PRICES AND ON CENTRALLY REPORTED PRICES, JUNE, 1943

City	Total number of comparisons	Percentage of individual store prices			Percentage difference between food cost aggregates*
		Same as headquarters prices	Lower than headquarters prices	Higher than headquarters prices	
Atlanta	1,560	72	11	17	+0.1
Detroit	3,335	75	10	15	+1.0
Milwaukee	1,121	74	9	17	+1.7
San Francisco	1,701	89	6	5	−0.6
Scranton	1,255	77	13	10	−0.1
Washington, D. C.	1,394	79	6	15	+1.1
All cities	10,366	78	9	13	+0.6

* The average prices for the different foods were combined with the weights used in calculating the index.

headquarters (Table IV). In 4 of the cities, there were more prices in the individual stores above the headquarters price than below; in two cities, San Francisco and Scranton, the reverse was the case. The comparison is best summarized in the percentage difference between the food cost aggregates obtained combining the average prices for each food with the weights used in calculating the index. The average prices reported by the individual stores resulted in aggregates that ranged in the 6 cities from 0.6 per cent below to 1.7 per cent above the aggregates based on the average prices reported by the central offices.

(3) Prices paid by purchasers. The third test was a comparison of prices secured by the Bureau's representatives with prices actually paid

by purchasers. A special group of Bureau of Labor Statistics agents unknown to the Bureau's regular respondents was provided with funds and ration points and instructed to buy certain items from the regular list of commodities in 12 cities. The purpose of this test was to discover whether there was any tendency on the part of store managers interviewed regularly by the Bureau's representatives to report prices differing systematically from those charged their customers on the same date. The agents making the purchases were provided with a list of the brands and specifications of foods priced in May in each of the stores included in the test. These agents were not the agents who regularly visit these stores. They were expressly selected for this job and went to the stores as ordinary customers and were in no way identified as Government employees. These agents were strangers in the stores and might therefore be subject to any differential treatment that the retailer may accord to different groups among his patrons.

After the purchases were made, the shopper requested a receipt from the person serving him. This receipt did not as a rule record prices for the individual foods, grades, or qualities of the foods purchased. After the shopper had left the store he prepared a report showing, by store name and outlet number, the foods purchased, the quantity of each, the total cost, and the stated price per unit. The amount for each article in general appeared on the receipt, but the other quantitative information had to be supplied from memory. Brands and grades were recorded for canned and packaged goods. The shopper had no definite assurance that the retailer had supplied him with the grade of meats requested and, therefore, no quality information was listed for the meats.

The purchase reports were then compared with the price reports obtained from the regular monthly interview with the owner or manager of the store. Prices paid tended to be above prices reported for items in the meat, fresh fruit and vegetable groups. In other foods the prices paid by purchasers and the prices reported to agents were in substantial agreement. The magnitude of the differences is illustrated by the unweighted averages of the prices of 24 foods in the 12 cities.

If a purchaser bought the list of foods purchased in this test and if the test purchase prices had been combined with the weights used in the cost of living index in June, his bill would have been 1.7 per cent greater than that calculated from the prices reported to the Bureau.

This simple comparison, however, does not describe the situation accurately because subsequent analyses by the Committee's staff have shown that the list and quantities of foods purchased were not strictly comparable with those regularly priced. If allowance is made for these

differences and a similar grocery bill is calculated with the weights used in the cost of living index, the difference is only 1 per cent. In detail, analysis indicated that when the differences between the prices paid and the prices reported were appraised food by food and store by store, certain reports on purchases were eliminated from the comparison because the grade or brand differed from that shown on the regular price

Item and unit	Averages of reported prices (*cents*)	Averages of purchase prices (*cents*)
Flour, wheat, 5 lbs.	33.5	33.6
Macaroni, 8 oz. pkg.	8.7	8.7
Corn flakes, 11 oz. pkg.	9.9	10.0
Rolled oats, 20 oz. pkg.	11.8	11.7
Round steak, 1 lb.	48.9	50.3
Chuck roast, 1 lb.	33.5	35.4
Veat cutlets, 1 lb.	54.7	55.2
Pork chops, 1 lb.	42.8	42.9
Bacon sliced, ½ lb.	23.7	23.8
Ham sliced, 1 lb.	59.4	59.5
Milk, evaporated, 14½ oz.	10.4	10.4
Cabbage, 1 lb.	10.2	10.4
Carrots, bunch	8.4	8.7
Potatoes, 1 lb.	5.6	5.8
Peaches, #2½ can	26.4	26.9
Pineapple, #2½ can	32.4	32.4
Grapefruit juice, #2 can	14.8	14.9
Beans, green, #2 can	15.8	16.0
Corn, #2 can	15.0	15.1
Peas, #2 can	15.4	15.4
Tomatoes, #2 can	13.8	13.8
Navy beans, 1 lb.	11.1	11.3
Salad dressing, 1 pt.	27.3	27.6
Corn sirup, 24 oz. bottle	16.3	16.5

report. The best-selling brand within the specification had shifted in some retail stores and in accordance with the established practice the price reporters had obtained the price for a different brand in June, and a new May price for the same brand. There was, accordingly, no June report for the brand bought by the shopper.

The other differences between prices paid and the prices reported were then appraised in terms of the possibility of errors in the shopper's reports on quantity purchased and grade or brand received. For example, a shopper's report of the purchase of 2½ pounds of chuck roast for 85 cents was considered consistent with a price of 35 cents a pound, since the weight recorded was doubtless a "rounded" estimate. Forty-seven per cent of all the differences between the pairs of prices could be

explained by the purchase of a different grade from that priced or by inaccuracies in the reported quantities. The relatively large number of such cases accents the difficulties of using reports of purchases as a method of recording prices and price changes.

Out of a total of 809 comparisons there were, after editing for comparability, 97 cases which might be considered indicative of errors in the regular price reports. Most of these differences, particularly those in which the purchase price exceeded the reported price, occurred in foods for which the retailer had been reporting the same price for two or more months. This suggests that a few of the regular reporters may fall into the habit of reporting no changes in many of their prices, in order to shorten the interview. This inference is further supported by the fact that such cases tended to be concentrated in certain stores. With the increasing difficulties that retailers are facing in the conduct of their business, there may be an increase in the number of retailers regarding the monthly price report as a chore to be completed as quickly as possible.

The Bureau has continuously revised its sample of stores in each city and at the present time is directing the revisions so that the distribution of the stores in the sample conforms to the distribution shown by the Census for sales-volume groups. Substitutes are being introduced for stores that appear not to be giving completely accurate reports.

Comparison of price reports with ceiling prices. At the present time, a new type of question on the accuracy of the price reports has been raised: Do the respondents report the actual selling prices or the legal (ceiling) prices? To investigate this problem, a comparison has been made of the prices reported and ceiling prices of five pork products at selected dates in the stores in 56 cities. The results of this study, presented in Table V, show that 25 per cent of the prices quoted to the Bureau as of April 20 were above the dollar and cents ceilings established on April 1. These percentages state number of price quotations above ceiling prices in relation to the total number of price quotations collected by the Bureau. They do not provide an estimate either of the relative number of individual stores charging more than the ceiling price or of the proportion of sales at prices above the legal limits.

For the same purpose, a comparison of prices for canned fruits and vegetables on which community ceilings had been established in Cleveland for July 13, 1943, showed that 55 per cent of the canned fruit and 50 per cent of the canned vegetable quotations received by the Bureau were above community ceiling prices. In the Atlanta region, 22½ per cent of price reports to the Bureau in 16 cities on September 14 were

above ceiling levels, and in the Denver region, 37 per cent of the meats, 24 per cent of the canned fruits, approximately 19 per cent of the eggs, and 14 per cent of the canned vegetables priced on August 17 were above legal ceilings. These findings indicate that the prices reported to the Bureau are not limited to the legal price limits.

TABLE V

PER CENT OF PRICE QUOTATIONS ABOVE CEILING PRICES FOR SPECIFIED ITEMS BY CLASS OF STORE AND DATE*

Class of store† and date	Pork chops	Bacon, sliced	Ham, sliced	Ham, whole	Salt pork	All cuts
Quotations from OPA Class 1 and 2						
April 20, 1943	19	24	33	29	29	26
May 18, 1943	13	18	29	27	24	22
July 13, 1943	42	55	63	54	55	53
August 17, 1943	31	43	54	45	50	43
Quotations from OPA Class 3 and 4						
April 20, 1943	21	17	29	16	23	21
May 18, 1943	19	17	20	18	18	18
July 13, 1943	30	38	26	32	28	33
August 17, 1943	21	32	32	26	20	26
All Quotations						
April 20, 1943	19	22	32	26	27	25
May 18, 1943	14	18	27	24	23	21
July 13, 1943	40	51	57	48	48	49
August 17, 1943	29	41	49	40	42	40

* The percentages in this table are based on the number of quotations above the price ceilings in relation to the total number of quotations for the specified product. They cannot be used to estimate either the number of stores charging prices above ceiling or the volume of purchases made at prices above the legal limits. To obtain such estimates it would be necessary to derive weighted totals of the reports by class of store and by city.

† Class 1 comprises independent stores having less than $50,000 annual sales; Class 2, independent stores with annual sales between $50,000 and $250,000; Class 3, stores having less than $50,000 annual sales and belonging to corporate chains, and Class 4, all stores with annual sales in excess of $250,000.

Use of specifications in obtaining retail prices in the war period. The retail prices which form the basis of the Bureau of Labor Statistics cost of living index represent the cost of goods of the same quality in successive months, insofar as it is possible to price goods of the same quality in wartime markets. As previously explained, the Bureau's field representatives are provided with detailed descriptions of quality and they secure current prices of goods of the defined qualities from store managers and store buyers in personal interviews. When goods of the kind previously priced disappear from the market, new specifications are written to describe the articles currently available and which have the same use. Variations among different stores in qualities sold and the limited information available in regard to the quality of the goods sold

make it necessary to allow a range of quality within each specification. With the aid of these specifications and of their training in evaluating merchandise, the Bureau's representatives normally are able to obtain prices of goods of the same general quality from one pricing period to the next. The task at the present time, however, is especially difficult because wartime shortages necessitate frequent changes in the use of materials and designs by manufacturers, and it is no doubt true that goods of poorer quality are being priced in certain types of merchandise. It would be possible to follow prices of goods of equivalent serviceability more accurately if there were closer quality controls in the production of consumers' goods, and if manufacturers labeled the quality of the goods they produce (by grade, or some other objective measurement). Informative labels which identify the quality of the goods sold are available in relatively few retail stores and for very few commodities in these stores.

The Bureau follows the policy of continually developing new specifications to insure that the list of goods priced for the index is representative of current purchases. In pricing for the June 1943 clothing-cost index, 68 new specifications were used; for example, specifications for 4 grades of rayon stockings, 1 grade of cotton anklets, and 6 qualities of men's suits were added.

Information supplied by manufacturers makes it possible to ascertain changes in materials and construction a season ahead of the appearance of new types of goods in retail stores. Differences in marketing procedures and in climatic conditions in different parts of the country sometimes result in the introduction of new products in the metropolitan areas in the North in one quarter, and in the smaller cities or in the South the following quarter.

In periods of changing incomes, store buyers report that their sales volumes have shifted and thus they recommend pricing in the current period a new item which is within the quality range allowed by the specification but is higher in price than the article priced in the past. When such a change is reported the Bureau's representatives take special care to ask about the new quality in as much detail as possible in order to determine whether the change represents a shift in both quality and price or a change in price only.

When a substitution is made because the quality of the article selling in greatest volume has changed, and the article previously priced is still obtainable, the price of the new article in the current period is compared with its price in the previous period in calculating the index. This process is known as "linking."

The linking process is not used if a commodity which has been a

volume-seller disappears from the market (and from the cooperating outlet in particular) and only higher-priced substitutes are available. The price change shown in this case is calculated in one of two ways. If the higher-priced commodity were a new one the full percentage increase is used in calculating the index. If, on the other hand, the new commodity had been available in the previous pricing period and had been sold in large volume alongside the previously specified commodity, the price change from the old commodity to the new one is determined over two pricing periods by relating the price of the new to the average price of the old and new in the first period. This procedure is followed on the assumption that many members of the group to which the index applies purchased the higher-priced article in the earlier period. Since it is impossible to obtain information on the volume of sales for each quality to the public at large, much less to this particular group, the two prices for the earlier period are given equal weight in the average.

These procedures, which take account of the effect of the disappearance of lower-quality merchandise on the actual cost of living of the wage earner and clerical group, were the most important factors in producing increases in the clothing-cost index in July and August 1943 and were important factors in the increase shown for September 1943.

APPRAISAL OF THE METHODS OF DERIVING AND ADJUSTING THE WEIGHTS

General description. The original cost of living index of the Bureau of Labor Statistics was developed from data on the consumption of wage earners and clerical workers in large cities during the period 1917–19. Cost of living indexes, based on the 1917–19 consumption data were published at regular intervals from February 1921 through 1934. In 1935, the Bureau improved the method of calculating the index and introduced a completely revised system of weights.

A fixed-weight index may remain valid, according to the definition of the index, over a considerable period of time and possibly, with minor revisions, for as long as a decade. Eventually, however, the consumption pattern represented in the index becomes outmoded, and must be completely revised. In the period between 1920 and 1935 many goods and services not commonly sold at the time of the original expenditure study became part of the consumption of wage-earner and clerical groups. Subsequent changes in the price relationships among the various commodities in the family budget altered the relative importance of the goods and services represented in the index and the need for new expenditure data became apparent.

From 1934 through 1936 the Bureau conducted a Nation-wide study of the money disbursements of wage earners and lower-salaried clerical workers. This study, conducted in a period when there was widespread unemployment and large relief rolls, was so planned that it would produce information on expenditures of wage earners and clerical workers living in relatively "normal" circumstances. Consequently, the sample was confined to families with at least one earner, who was employed a specified length of time during the survey year and who had earnings of at least $300 during this period. In addition, no families who had received direct relief or work relief during the year were included. The result of these restrictions was to provide data for cost weights in the index at an expenditure level that would become more representative as the Nation moved towards full employment. Had the Bureau elected to describe the expenditure level prevailing at the time of these surveys, the weights in the index would have deviated markedly from the average plane of living of the groups represented within a few years.

The information from these surveys formed the basis of the revised weights. The net effect of the changes is illustrated by the group weights for all cities shown below.

Item	Relative importance in the index in 1935–39 for: *Original index*	*Revised index*
Food	31.1	33.9
Clothing	13.8	10.5
Rent	16.0	18.1
Fuel, electricity and ice	6.3	6.4
Housefurnishings	4.7	4.2
Miscellaneous	28.1	26.9
All items	100.0	100.0

The changes in the group weights, in themselves, although relatively large, did not constitute the major alterations in the construction of the index. The changes in the weights for items within groups were more significant, especially in the furnishings and miscellaneous categories. Nevertheless, the comparison of the new and the original index over the period for which both were computed does not reveal large differences in movement.[3]

Changes made in the index in the recent period. The changes in the types of goods and services available to civilians during 1942 and 1943 have necessitated more extensive revisions of the weights than is required in peacetime. These changes are described in an article by

[3] See Charts 2 and 3, Bureau of Labor Statistics, Serial No. R.1156.

Faith M. Williams entitled, "Bureau of Labor Statistics Cost-of-Living Index in Wartime," in the *Monthly Labor Review*, July 1943.

By December 1942 the following goods were dropped from the indexes for all cities: new and used automobiles, refrigerators, washing machines, metal bedsprings, studio couches and innerspring mattresses, sewing machines, vacuum cleaners, gas cook stoves and silk stockings, slips and yard goods. Rayon stockings, cotton hose for women and girls were added to all city indexes and cotton felt mattresses were included in the 22 cities where they were available. The weights for automobile repairs, street car and bus fares and for rayon yard goods and slips were increased while the weights for gasoline and oil and for fuel oil in the area defined by ration order No. 11 were decreased.

Effect of changes in weights on the movement of the index. The effect of the various changes in weights which have been made in the BLS cost of living index since the beginning of the war has been measured by the Committee in two different ways. In the first place, the indexes for

TABLE VI

COST OF LIVING INDEXES PUBLISHED FOR FIVE CITIES FROM DECEMBER 15, 1941, TO FEBRUARY 15, 1943, AS COMPARED WITH INDEXES RECOMPUTED WITH WEIGHTS USED IN CALCULATING COST OF LIVING INDEX FOR FEBRUARY 1943*

(December 15, 1941 = 100)

Date	Birmingham		Chicago		Denver		New York		San Francisco	
	Published index	Recomputed index	Published index	Recomputed index	Published index	Recomputed index	Published index	Recomputed index	Published index	Recomputed index
1941:										
Dec. 15	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1942:										
Jan. 15	101.1	101.0	101.3	101.2	101.7	101.8	101.5	101.4	102.3	102.5
Feb. 15	102.2	102.1	101.6	101.5	102.2	102.2	102.1	102.1	102.6	102.7
Mar. 15	103.0	102.9	102.8	102.7	103.4	103.5	103.0	103.0	104.0	104.0
Apr. 15	103.6	103.8	104.2	104.2	104.8	104.9	103.6	103.6	105.1	105.2
May 15	104.2	104.2	105.3	105.3	105.7	105.8	104.2	104.2	105.7	105.8
June 15	102.8	102.6	105.2	105.1	105.8	105.9	105.1	105.0	105.9	106.1
July 15	102.9	102.7	105.2	105.2	106.0	106.2	106.0	105.9	106.3	106.5
Aug. 15	104.3	104.1	106.1	106.1	106.3	106.6	106.9	106.9	107.5	107.7
Sept. 15	104.3	104.1	106.1	106.1	107.1	107.4	107.0	107.0	108.6	108.9
Oct. 15	105.3	105.1	107.5	107.6	107.7	108.0	108.0	108.0	109.3	109.6
Nov. 15	105.3	105.1	108.0	108.1	108.3	108.6	109.0	109.0	111.1	111.4
Dec. 15	106.1	105.9	108.0	108.1	109.2	109.5	109.8	109.8	111.4	111.7
1943:										
Jan. 15	106.5	106.3	108.3	108.4	109.3	109.6	110.2	110.3	111.9	112.2
Feb. 15	106.6	106.4	109.0	109.1	110.0	110.2	110.6	110.6	111.9	112.3

* This calculation was made by dropping from the monthly aggregates from January 1941 to January 1943 all those goods not used in computing the February 1943 index, and making the appropriate change in the aggregates for goods which were included in the February 1943 index with different weights from those of the base period, for example, reducing the aggregate for gasoline, and increasing the aggregate for street car fares.

five cities were recalculated on the basis of the weights used in calculating the February 1943 index. Since the first weight change was made in January 1942, the index was recomputed back to December 1941. The results of this calculation are shown in Table VI. These indexes were calculated by dropping from each monthly aggregate, beginning with December 1941, the aggregate for the goods not available in February 1943, and by making the appropriate change in each aggregate for which the weight was different in February 1943 than in the base period. The result of this procedure was to produce indexes with constant weights from December 1941 to February 1943. As of the latter date, there was no difference between the recomputed series and the published indexes for New York City. Among the other cities, the greatest difference appeared in the San Francisco index, where it amounted to 0.4 of an index point.

Secondly, the index for all cities combined was recalculated on the assumption that money which could not be spent for goods no longer available would have been spent for goods within the same index group

TABLE VII

THE COST OF LIVING INDEX AS PUBLISHED, AND AS IT WOULD HAVE BEEN IF IT HAD BEEN ASSUMED THAT MONEY WHICH WOULD HAVE BEEN SPENT FOR GOODS NOT NOW AVAILABLE HAD BEEN SPENT FOR AVAILABLE GOODS WITHIN THE SAME INDEX GROUP,* DECEMBER 15, 1941, TO DECEMBER 15, 1942

(1935–39 = 100)

Date		Cost of living index computed without adjustments	Cost of living index as published
1941:	December 15	110.5	110.5
1942:	January 15	112.0	112.0
	February 15	112.8	112.9
	March 15	114.2	114.3
	April 15	115.1	115.1
	May 15	116.0	116.0
	June 15	116.3	116.4
	July 15	116.9	117.0
	August 15	117.4	117.5
	September 15	117.7	117.8
	October 15	118.9	119.0
	November 15	119.6	119.8
	December 15	120.2	120.4

* Computed by applying relative changes for each index group, as published, to the corresponding aggregate as of December 15, 1941.

of commodities. For instance, it was assumed that some of the money previously spent on gasoline for automobile travel was spent for other kinds of transportation; that more of the money formerly spent on automobile purchases was spent on repairs, etc. The index which was

obtained by the second calculation is shown in Table VII. This index was computed by applying to the dollar aggregates for each group of goods and services relative changes in costs for that group as published. The recomputed index (shown in Table VII) was lower than the published cost of living index for December 15, 1942, by two-tenths of a point; this lower level was due to the increased weight resulting from the computation which fell upon the more stable items in the index. Table VIII shows the effect of the recomputation on the relative importance of the various groups of items.

TABLE VIII

CHANGES IN RELATIVE IMPORTANCE OF DIFFERENT GROUPS OF ITEMS, DECEMBER 15, 1942, EFFECTED BY RECOMPUTATION

Items	In the BLS index as published		If it had been assumed that money which would have been spent for goods not available had been spent for available goods within the same index group
	December 15, 1941	December 15, 1942	December 15, 1942
All items	100.0	100.0	100.0
Food	36.2	41.0	39.0
Clothing	11.4	12.1	11.5
Rent	18.4	17.8	16.9
Fuel, electricity and ice	6.4	6.2	6.0
Housefurnishings	4.6	3.2	4.5
Miscellaneous goods and services	23.0	19.7	22.1

Effect of complete weight revision. If a revision similar to that introduced in 1935 were envisaged now, a similar expenditure study would need to be undertaken. The wage-earner and clerical groups have experienced an appreciable rise in average income since 1940. At the same time, prices have been rising and to a certain extent adjustments to price changes have been made possible by the increase in income. The weights in the index are based on the money expenditures of families that had in 1934–36 an average income of $1,524. The index represents the cost, at present prices, of the goods purchased in 1934–36 at the level of $1,524 income. At the present time, the average income of similarly defined population groups is probably well above $2,000. Their money expenditures are determined by the income, the price level and the availability of goods. To illustrate the degree of difference between the allocation of expenditure costs in the index and the expenditure pattern prevailing at a time other than the base period, data from the Bureau of Labor Statistics "Survey of Spending and Saving

in Wartime" for the first quarter of 1942 for wage earners and lower-salaried clerical workers in large cities are compared with the expenditure weights in the index for February 1942, in the accompanying tabulation.

Item	Cost* weights in cost of living index, February 1942†	Expenditures* by wage earners and clerical workers in large cities, 1st quarter, 1942	
		All income levels	*Income level $1,500*
Food	35.1	32.8	34.3
Housing and fuel	23.3	18.4	21.4
Housefurnishings	4.5	4.8	3.3
Clothing	11.1	11.8	10.6
Miscellaneous	26.0	32.2	30.4
All items	100.0	100.0	100.0

* Percentage of total costs.
† Income level in 1934–36 was $1,524.

An index based on average current expenditures for current income levels would put less emphasis on housing, slightly less on food, and more weight on the miscellaneous groups. If, beginning in February 1942, the group indexes had been weighted by the distribution of the average actual expenditures of all wage earners and clerical workers in large cities in the first quarter of 1942 (column 2 above) the change in the index from February 1942 to October 1943 would have been 10.2 per cent. This was exactly the change shown by the index computed according to the 1934–36 weights adjusted for shortages.

APPRAISAL OF THE CITY SAMPLE

In 1940 there were 199 cities having a population of 50,000 or more in the continental United States. The national (average) cost of living index of the Bureau of Labor Statistics is based on a sample of 34 of these cities as shown below.

1940 population	United States: *Number of cities*	United States: *Total population (thousands)*	BLS sample: *Number of cities*
500,000 or more	14	22,368	14
100,000–500,000	78	15,620	16
50,000–100,000	107	7,344	4
Total	199	45,332	34

The cities in the sample comprise 61 per cent of the total population

in large cities. Two of the cities, New York and Chicago, have nearly one-fourth of the urban population in cities of 50,000 or more.

The indexes for each city are combined to form the national average by weighting each city index so that it represents the population in the cities in the surrounding area. The weight for the city of Detroit, for example, is based upon its own population plus that of Jackson, Kalamazoo, Toledo, Grand Rapids, Flint, Lansing, and Saginaw. The population weights of the cities in the index which were revised in March 1943 on the basis of the data from the 1940 Census,[4] and the population estimate derived from the distribution of the sugar-ration books are shown below.

Region and city	Population weight	Region and city	Population weight
North Atlantic:		South Central, continued:	
Boston	8.8	Mobile	.3
Portland, Maine	.2	Houston	3.9
Manchester	.1	New Orleans	1.1
Buffalo	3.9	North Central:	
New York City	13.4	Chicago	8.1
Philadelphia	7.2	Milwaukee	1.7
Pittsburgh	4.2	Indianapolis	2.2
Scranton	.9	Cincinnati	4.1
South Atlantic:		Detroit	6.1
Baltimore	1.8	Cleveland	3.6
Washington	1.9	St. Louis	2.5
Richmond	1.0	Kansas City	2.8
Norfolk	.7	Minneapolis	1.7
Atlanta	1.3	Western:	
Savannah	.6	Denver	1.2
Jacksonville	1.1	Seattle	1.3
South Central:		Portland, Oregon	.7
Birmingham	2.0	San Francisco	3.1
Memphis	.9	Los Angeles	5.6

The combination of the city data in the national average may be expressed by the formula: $(\sum n_i e_i R_i)/(\sum n_i e_i)$ where n is the population weight and e_i is the cost weight in the base period, and R_i is the index for the ith city. The influence of each city in the national average depends both on the population weight and the expenditure level of wage earners and clerical workers in that city in the base period. The cost of the goods purchased by clerical workers in 1934–36 in each of the 34 cities is shown below, at average 1935–39 prices.

The families of wage earners and clerical workers in both New York and Chicago had relatively high expenditures in 1934–36 as compared

[4] For a complete list see *Monthly Labor Review*, July 1943: "The Bureau of Labor Statistics Cost of Living Index in Wartime."

with similar families in other large cities, and consequently the expenditure weight of these cities in the national index is even greater than if the weight represented population alone.

Atlanta	$1315.02	Milwaukee	$1591.71
Baltimore	1350.06	Minneapolis	1593.99
Birmingham	1287.01	Mobile	1191.80
Boston	1593.58	New Orleans	1215.69
Buffalo	1533.28	New York	1846.31
Chicago	1659.25	Norfolk	1355.48
Cincinnati	1480.34	Philadelphia	1590.33
Cleveland	1639.68	Pittsburgh	1527.32
Denver	1524.34	Portland, Me.	1476.96
Detroit	1692.73	Portland, Ore.	1499.58
Houston	1447.05	Richmond	1428.88
Indianapolis	1452.91	St. Louis	1507.31
Jacksonville	1339.14	San Francisco	1690.05
Kansas City	1400.54	Savannah	1182.22
Los Angeles	1587.77	Scranton	1422.70
Manchester	1454.46	Seattle	1588.04
Memphis	1238.84	Washington, D.C.	1958.81

Tests show that the number of cities in the sample is large enough to provide a stable national average. In March 1943, when the all-city index was 126, the standard deviation of the city indexes from their

TABLE IX

COST OF LIVING INDEXES OF TWO SUBSAMPLES OF THE 34 LARGE CITIES AND THE BLS COST OF LIVING INDEX, FOR SPECIFIED DATES*

(1935–39 = 100)

Item	March, 1939			March, 1942			March, 1943		
	Sub-sample 1	Sub-sample 2	Published BLS	Sub-sample 1	Sub-sample 2	Published BLS	Sub-sample 1	Sub-sample 2	Published BLS
All items	99.7	99.3	99.1	114.3	113.9	114.3	121.5	121.8	122.8
Food	94.9	94.2	94.6	119.8	118.0	118.6	138.8	136.9	137.4
Clothing	100.5	100.4	100.4	124.6	123.3	123.6	128.4	127.6	127.6
Rent	104.4	104.4	104.3	109.7	108.8	108.9	108.0	108.0	108.0
Fuel	101.0	99.4	100.1	103.9	104.0	104.5	106.2	106.8	107.4
Housefurnishings	101.0	100.9	100.9	121.3	120.6	121.2	123.8	121.6	124.5
Miscellaneous	100.5	101.2	100.5	108.6	109.7	110.1	113.0	114.6	114.5

* Each subsample included 18 cities, New York and Chicago, and 16 of the other large cities, selected as representative with respect to region and city size.

average was 0.37 points, that is, the variation in the monthly change in the individual cities amounted to about three-tenths of a per cent. In order to corroborate the usual tests of significance of the average,

the 34 cities in the sample were divided into two subsamples of 18 cities each selected on a stratified random scheme.[5] The indexes calculated for these two subsamples are shown in Table IX. The two subsamples were in substantial agreement, although the first tended to give consistently higher values than the second, a finding which may appear in samples when all of the measures are positively correlated.

The Bureau of Labor Statistics also collects data and constructs indexes for a sample of 20 small cities (see Table I) representing cities with population of 5,000 and less than 50,000. These 20 cities have a total population of 374,996 which represents 1.6 per cent of the total population of the 1,843 cities which in 1940 had populations within this range. The number of small cities in the index sample compared with the number in each population group of cities is shown below.

1940 population	United States *Number of cities*	United States *Total population (thousands)*	BLS Sample *Number of cities*
25,000–50,000	213	7,417	6
10,000–25,000	665	9,967	9
5,000–10,000	965	6,682	5
Total	1,843	24,066	20

The number of cities for which the Bureau conducts cost of living studies is not large enough to provide regional or state averages. Even though two out of three large cities in a state may be represented in the index, they may not give a sound basis for driving an estimate of all the cities in the state. The city is so large a sampling unit that even a large "sample" of the cities in a geographic area may yield averages that are biased estimates of averages for the total group of cities.

The national average cost of living has uses in connection with many problems of economic analysis and administrative policy. It is possible that regional or state averages would have similar usefulness in connection with regional or state problems, but indexes for geographic groups would prove more useful if the coverage extended beyond the large cities.

COMPARISON OF THE BUREAU OF LABOR STATISTICS INDEX WITH OTHER INDEXES

State indexes. Several state agencies prepare cost of living indexes for cities in their states. The Bureau of Labor Statistics assisted the Penn-

[5] Because of the importance of New York City and Chicago, they would be included normally in any stratified sample. They were, therefore, included with 16 other cities in each of the subsamples.

sylvania Department of Labor and Industry, the Michigan Department of Labor and Industry, and the Bureau of Business Research of the Louisiana State University in inaugurating their indexes, by preparing weights for their use and by transmitting copies of the Bureau's schedules and specifications, for adaptation to their situations. At their request the Bureau trained their field agents in its price-collection methods and their office staffs in its method of office computation. The Bureau does not, however, correspond with these agencies currently on the matter of editorial decisions arising in the processing of the data. The procedures used by the Massachusetts Division of the Necessaries of Life and the New Jersey Department of Agriculture are completely independent of those of the Bureau. In general the price changes as shown by the state indexes for commodity groups and for all living costs are of the same order of magnitude as the changes measured by the Bureau in cities or groups of cities in the same region. The few large differences can be explained on the basis of differences in methods of price collection. In Pennsylvania, Michigan and Louisiana, the state indexes are prepared for communities not included in the Bureau's sample, and the state agencies in Massachusetts and New Jersey do not publish separate figures for the cities in these states covered by the Bureau. Hence, strict comparisons of the Bureau's series with state series are not possible.

National Industrial Conference Board cost of living indexes. The National Industrial Conference Board currently computes two series of cost of living indexes—one based on a "pre-war fixed weight budget," the other on a "wartime budget" based upon the pre-war budget adjusted by methods similar to those adopted by the Bureau of Labor Statistics.

The indexes for the pre-war budget are computed separately for 70 cities and for the United States. The national index is based on data from many cities in addition to those for which separate indexes are prepared. This series extends back to 1914 and is based upon a list of goods and services similar to that used in the Bureau of Labor Statistics index prior to 1942.

In May 1943, the Board began publication of revised indexes for individual cities and by October had completed revision of indexes for 58 cities. These revisions take account of data received too late for inclusion in the current monthly figures and utilize newly available family-expenditure data. The revisions include changes in budgetary weights. Publication of a series of indexes based on a "wartime budget" began in the late spring of 1943.

A comparison of the percentage change from March 1942 to Sep-

tember 1943 in the indexes series for the 27 cities covered by both agencies shows that in 19 of the 27 cities, the BLS index advanced more rapidly than the NICB war-time index, and in 16 cities, it advanced more rapidly than the NICB pre-war index. The greater change in the BLS indexes was caused chiefly by larger increases shown in the cost

	Number of cities for which same percentage change was shown by BLS and NICB	Number of cities for which greater percentage change was shown by BLS	and NICB
Comparison with NICB wartime series:			
All items	0	19	8
Food	0	13	14
Clothing	0	21	6
Rent	2	15	10
Fuel, electricity and ice	1	14	12
Housefurnishings	0	19	8
Miscellaneous	0	25	2
Comparison with NICB pre-war series:			
All items	0	16	11
Food	1	14	12
Clothing	0	22	5
Rent	2	15	10
Fuel, electricity and ice	1	12	14
Housefurnishings	1	18	8
Miscellaneous	0	19	8

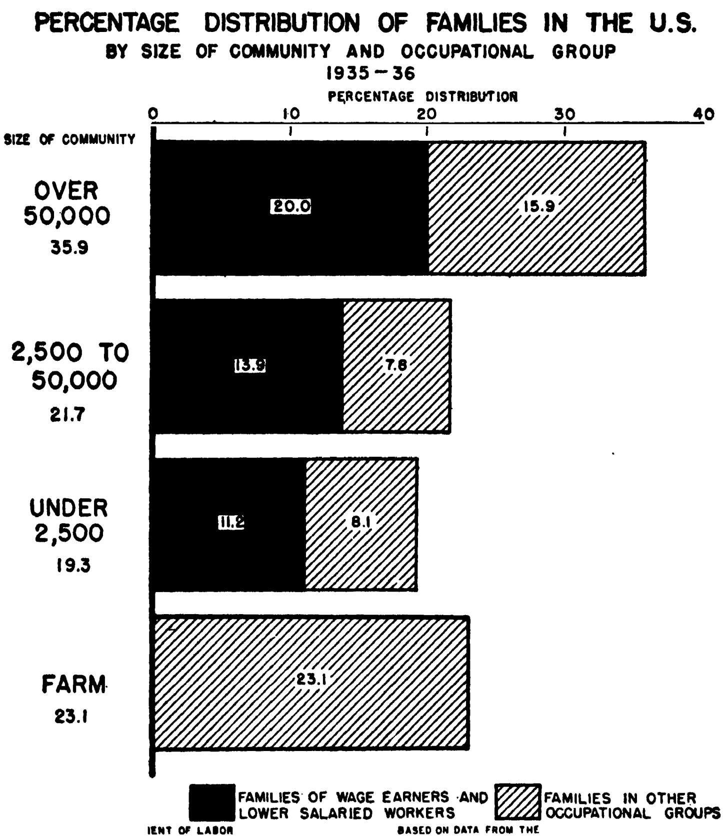
of clothing, housefurnishings, and miscellaneous items. The following tabulation shows the number of cities for which the change in the BLS index was higher than the change in the indexes based on NICB wartime budget and NICB pre-war budget, between March 15, 1942, and September 15, 1943. In the same period the relative change in the cost of living in all large cities amounted to an increase of 8.4 per cent in the Bureau of Labor Statistics series and to an increase of 7.1 per cent in the pre-war and of 7.2 per cent in the wartime series of the National Industrial Conference Board.

THE INDEX AS REPRESENTATIVE OF BROADER POPULATION GROUPINGS

The groups represented by the index of the Bureau of Labor Statistics, wage earners and clerical workers in large cities, comprised about 20 per cent of the total population as indicated in Chart I in the years 1935–36. The other official index based on retail prices—that of the

Bureau of Agricultural Economics—covering the *commodities* farmers buy represented another fifth of the population. Thus, about three-fifths of the population is not represented directly by any published index. The Bureau of Labor Statistics collects data on the cost of living of wage earners and clerical workers in 20 small cities which could be

CHART I

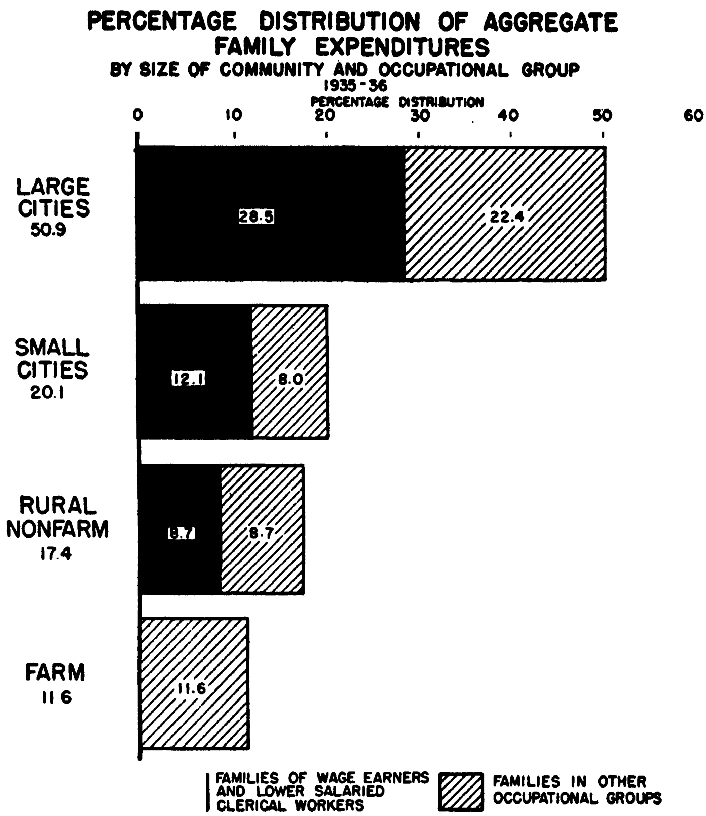


used as a preliminary basis for an index for wage earners and clerical workers in cities of 2,500 to 50,000 population. This group adds about 14 per cent of the population to the index "coverage," leaving over two-fifths of the population for which little or nothing is known about the changes in living costs.

The population groups just described are of unequal importance in

the hypothetical national index, in terms of the dollar value of their expenditures. The groups covered by the index for large cities and by the potential index for small cities have a greater weight in terms of dollar expenditures than in terms of population (Chart II). The one-third of the families of the country in the wage-earner and clerical

CHART II



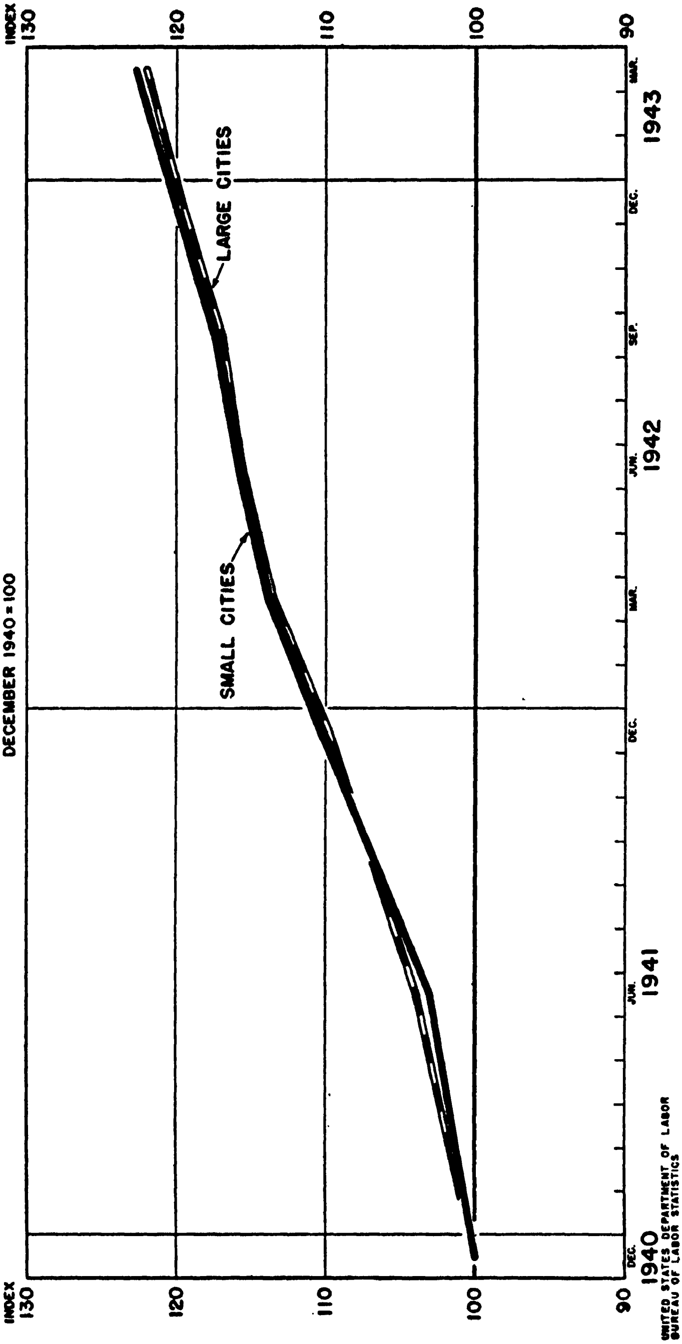
groups who lived in cities, large and small, spent 41 per cent of the total United States outlay for consumer goods and services in 1935–36. The farm population accounted for another 12 per cent of these aggregate expenditures, leaving 47 per cent of the total national expenditures not covered by a cost of living index.

The cost of living has increased somewhat more in small cities than

CHART III

AN ESTIMATED COST OF LIVING INDEX FOR SMALL CITIES COMPARED WITH THE BLS COST OF LIVING INDEX FOR LARGE CITIES

DECEMBER 1940 = 100



in large cities (Chart III). Hence a national index for wage earners and clerical workers in urban communities in the period for which data are available would be above the level of the large-city index. The general order of magnitude of such an index is illustrated in the estimates given below for the period December 1940 through March 1943.

Index for Wage Earners and Clerical Workers
(December 1940 = 100)

	In large cities	*In small cities (estimated)*	*In all cities (estimated)*
1940: December	100.0	100.0	100.0
1941: June	103.9	103.1	103.6
December	109.8	110.3	110.0
1942: March	113.5	113.8	113.6
June	115.6	115.8	115.7
September	117.0	117.5	117.1
December	119.6	120.1	119.7
1943: March	121.9	122.7	122.2

The index for wage earners and clerical workers in large cities (December 1940 = 100) was only 0.3 below the index for that group in all cities in March 1943.

The groups whose expenditures formed the base period weights for the cost of living index in large cities had an average money income of $1,524 in 1934–36. All urban families in 1935–36 had an average income of $1,785. The differences in expenditure patterns for these two levels of average income are slight, as is indicated by the following group percentages.

	Per cent of total expenditures	
	*Wage-earner and clerical families in 1934–36**	*All urban families in 1935–36†*
Food	33.5	31.3
Housing	17.1	15.5
Household operation (incl. fuel)	10.9	12.2
Furnishings	4.0	3.5
Clothing	10.6	10.3
Automobile	5.8	7.8
Medical care	3.9	4.6
Personal care	2.0	2.2
Recreation	5.5	6.3
Education	0.5	1.0
Gifts	2.9	3.4
Other	0.8	0.4

* U. S. Department of Labor, Bureau of Labor Statistics, Bulletin No. 638: *Money Disbursements of Wage Earners and Clerical Workers, 1934–36.*

† National Resources Committee, *Family Expenditures in the United States, 1935–36.*

These differences in group weights would alter the index very little if the constituent items priced for the index remained the same. The items chosen for an index applicable to the total urban population would doubtless differ in some respects from those that were selected for the index of wage earners in large cities. However, since the consumption of the numerically large middle group is represented in the index, the differences in the choice of items would result in a measure that probably would not deviate substantially from the published index.

An estimated index for all nonfarm families (urban and rural nonfarm families) may be compared with the Bureau of Labor Statistics index for large cities in the table below. This index was prepared for the Committee on the basis of the present figures for small and large cities and the different expenditure levels of groups living in large cities, small cities, and in rural nonfarm territory on the assumption that price changes in all small communities were the same as in the small cities. It appears that in the period for which such estimates can be made, the Bureau of Labor Statistics index was only slightly lower than an index representing *all* nonfarm families.

	BLS large-city index	Index for all nonfarm families (estimated)
	(December 1940 = 100)	
1940: December	100.0	100.0
1941: June	103.9	103.5
December	109.8	110.0
1942: March	113.5	113.6
June	115.6	115.6
September	117.0	117.2
December	119.6	119.9

INDEXES FOR DIFFERENT REGIONAL OR INDUSTRIAL GROUPS

The national index is often the most suitable in a given situation, but frequently it is used simply because no index exists for the geographic unit under consideration. The Bureau's indexes for individual cities coupled with the information assembled by several of the states give evidence of the degree of geographic variation in the changes in the cost of living of wage earners and lower-salaried clerical workers. Little or no information has been accumulated for estimating the variability of changes in the cost of living among the component groups in this broad classification or among the segments of the population not represented.

The percentage changes in the cost of living in 34 cities from August 1939 to September 1943 ranged from an increase of 21.4 per cent in

Minneapolis to an increase of 34.0 per cent in Norfolk. In approximately half of the cities the rise in the cost of living was in excess of the average. Most of the cities in which the rise in the cost of living was above the national average are in the South and the West. Since the small cities in these regions likewise have experienced a relatively great increase in the cost of goods and services purchased by wage-earner and clerical families, it is apparent that a national index cannot be taken as representative of the trend in the separate regions.

In order to develop indexes representative of particular groups, the price collection and the expenditure studies of the Bureau would have to be greatly expanded. The sample of 34 large cities plus the 20 small cities and other cities now included in cost of living studies by the Bureau is far too small to provide an adequate basis for regional or state indexes.

An index for a region would require a city sample composed of approximately as many cities as are now included in the national sample since the variation in the changes in prices in cities within a region is nearly as great as the variation in the price changes in all cities of the country. If indexes were prepared for 5 regions, the total city sample should include no less than 100 communities.

Indexes for industrial groups such as textile workers or coal miners would also require samples of stores in about as many communities as are now in the national sample. The present 34-city index includes only 2 cities in the coal-mining areas and 5 that may be called textile centers. An index for either group would require a larger representation of small towns than would be necessary for regional indexes, as workers in both these industries are largely concentrated in small cities and towns.

INDEXES FOR DIFFERENT INCOME GROUPS

The index represents expenditures of what may be characterized as a moderate-income group. In periods of rapidly rising prices there are segments of the population with low (and fixed) incomes for whom the increase in the cost of living is a real hardship. During 1942 and 1943 prices of lower-quality goods and low-rent housing have experienced relatively the most extreme upward rise. An index for low-income groups would accordingly show a greater rise than the published index because the lower-quality goods have a heavier weight in their expenditure pattern. To measure the difference an index has been calculated for two dates for a low-income group defined as the urban families with incomes below the median in 1935–36 (Table X). The average expenditures of this group were divided among the categories as follows:

Total expenditures	$830
Food	326
Clothing	65
Rent	182
Fuel, electricity, ice	78
Furnishings	24
Miscellaneous	155

In Table XI, dollar expenditures and the percentage distribution of costs for subgroups in this index are shown in comparison with the weights for the Bureau of Labor Statistics index.

TABLE X

INDEXES OF COST OF LIVING OF WAGE EARNERS AND CLERICAL WORKERS AND OF LOW-INCOME GROUP IN URBAN POPULATION, DECEMBER 1942 AND MARCH 1943*

(August 1939 = 100)

Item	December 1942		March 1943	
	BLS index	Low-income group	BLS index	Low-income group
All items	122.1	124.5	124.5	127.8
Food	141.9	143.4	147.0	150.0
Clothing	125.5	130.2	127.2	132.3
Rent	103.5	106.6	103.5	106.6
Fuel, electricity and ice	109.0	108.1	110.2	109.7
Housefurnishings	123.0	124.8	123.8	125.8
Miscellaneous	112.4	110.1	114.0	111.9

* The low-income group was defined as the half of the urban population with incomes below the median in 1935–36.

By December 1942 the cost of goods and services purchased by the low-income group had risen 24.5 per cent as compared with August 1939. By March 1943 the advance had reached 27.8 per cent. These percentage changes are based on the prices collected by the Bureau of Labor Statistics for the lowest-quality goods included in the regular index. The increases shown by the Bureau of Labor Statistics cost of living index for the corresponding dates were 22.1 and 24.5. The substantial differences in the weights thus resulted in less than 4 points difference in the index since many of the changes were offsetting.

This comparison was limited to families of two or more persons maintaining households. A relatively large number of the economic units in the lower income brackets are single men and women, living in rooming or boarding houses. The changes in the cost of living for this group can not be estimated because data on room rentals, room and board, and restaurant meals have never been collected on a compre-

TABLE XI

EXPENDITURES OF LOW-INCOME URBAN FAMILIES IN 1935–36, AND OF EMPLOYED WAGE-EARNER AND CLERICAL FAMILIES, 1934–36

Expenditure group	Expenditures of low-income urban families*			Expenditures of employed wage-earner and clerical families†		
		Distribution of			Distribution of	
	Amount	Total expenditures	Group expenditures	Amount	Total expenditures	Group expenditures
	Dollars	Per cent	Per cent	Dollars	Per cent	Per cent
Food	*$326.00*	*39.3*	*100.0*	*$508.00*	*33.6*	*100.0*
Cereals and bakery products	53.15		16.3	79.25		15.6
Meat, fish, poultry	86.72		26.6	143.26		28.2
Dairy products	59.98		18.4	97.03		19.1
Eggs	19.23		5.9	27.94		5.5
Fruits and vegetables	67.48		20.7	109.72		21.6
Beverages	11.41		3.5	17.27		3.4
Fats and oils	15.32		4.7	16.26		3.2
Sugar and sweets	12.71		3.9	17.27		3.4
Clothing	*65.00*	*7.8*	*100.0*	*160.00*	*10.6*	*100.0*
Shoes	14.25		21.9	28.16		17.6
Overcoats, coats	8.80		13.6	21.44		13.4
Men's suits, trousers, jackets, overalls	10.84		16.6	28.32		17.7
Men's shirts, underwear, socks	7.93		12.2	20.32		12.7
Women's dresses, skirts	8.81		13.6	21.60		13.5
Women's underwear, hose	7.23		11.1	19.68		12.3
Hats, gloves, etc.	3.95		6.1	8.64		5.4
Dry cleaning, shoe repairs, etc.	3.19		4.9	11.84		7.4
Housefurnishings	*24.00*	*2.9*	*100.0*	*60.00*	*4.0*	*100.0*
Furniture	6.23		26.0	17.04		28.4
Household appliances	9.90		41.2	23.82		39.7
Textile furnishings	4.85		20.2	13.38		22.3
Other furnishings	3.02		12.6	5.76		9.6
Fuel, electricity, ice	*78.00*	*9.4*	*100.0*	*108.00*	*7.1*	*100.0*
Fuel	50.35		64.6	68.58		63.5
Electricity	20.08		25.7	27.00		25.0
Ice	7.57		9.7	12.42		11.5
Miscellaneous	*155.00*	*18.7*	*100.0*	*417.00*	*27.6*	*100.0*
Transportation	34.81		22.5	125.00		30.0
Medical care	31.98		20.6	59.00		14.1
Household operation	20.35		13.1	58.00		13.9
Recreation	31.00		20.0	82.00		19.7
Personal care	15.52		10.0	30.00		7.2
Gifts, contributions and unallocated items	21.34		13.8	63.00		15.1
Housing	*182.00*	*21.9*	*100.0*	*259.00*	*17.1*	*100.0*
All items	*$830.00*	*100.0*	*xxx*	*$1512.00*	*100.0*	*xxx*

* Urban families with incomes below the median in 1935–36. Data from National Resources Planning Board report, Family Expenditures in the United States.

† Data from U. S. Department of Labor, Bureau of Labor Statistics Bulletins No. 638 and No. 699.

hensive scale. The extension of index coverage to this group would be desirable not only because it is becoming numerically more important but also because, in times like the present, many persons live apart from their families with similar living arrangements.

PLACE-TO-PLACE COMPARISON OF THE COST OF LIVING

The question, "How much more does it cost to live in City A than in City B?" is one which arises repeatedly in wage negotiations in the setting of salary scales, and in considering the locations of new plants. Measurement of intercity differences in living costs during the same period requires comparing prices for identical items or for items which, making allowance for climate or custom, provide the same standard of living in each city. In particular the selection of articles must not be biased by differences in income levels prevailing in the separate communities.

The needs for such measures of geographic differences have multiplied in recent years. The construction of the necessary family budget involves a considerable amount of research to determine the differences in climatic requirements, local tastes and preferences that are independent of income differences. Once such a set of budgets is defined (or a methodology for their construction developed) the pricing would follow the same general lines as in the present index.

Lacking sufficient funds for original studies in this field, the Bureau of Labor Statistics has for some years calculated the approximate cost in a number of cities of a budget developed in the mid-thirties by the Works Progress Administration. Since the budget was constructed before the data were made available from the two large surveys of family expenditures made in the years 1934 through 1936, a revision in many details would be desirable.

If the pricing of a budget were extended to more and smaller communities, the Bureau could develop measures of the changes in the cost of living that arise from the combination of price change and a migration resulting in a significantly different distribution of families among the communities.

NOTES AND DISCUSSIONS

GEORGE H. VAN BUREN, 1874–1943

GEORGE *H. VAN BUREN, who retired from his active duties in the* Metropolitan Life Insurance Company on January 1, 1941, after 24 years of service, died suddenly on August 2, 1943, at the age of 69.

Mr. Van Buren was internationally known among vital statisticians and was a recognized authority on the classification of causes of death. He began his career in this field in the United States Bureau of the Census in 1900, where he was Expert Chief in the Vital Statistics Division from 1914 to 1916, and was largely responsible for the editing of the Census Bureau's annual reports on mortality in the United States and of various Census monographs and pamphlets on vital statistics. He was in complete charge for 10 years of the work relating to the classification of causes of death.

In 1920, he was the joint representative of the American Statistical Association and the American Public Health Association to the Paris International Conference on the Classification of Causes of Death. In 1929, he was appointed by the Government as delegate to the second of these conferences. Incidentally, it was he who prepared the translation of the first International List of Causes of Death from French into English.

He served for 21 years as Executive Secretary to the American Public Health Association's Committee on the Accuracy of Certified Causes of Death, and represented the American Statistical Association on the National Conference on Nomenclature of Diseases, being also a member of the Executive Committee of this National Conference. To the Statistical Bureau of the Metropolitan Life Insurance Company he gave, for almost a quarter of a century, the full measure of his experience gathered in these fields.

His warm personality had won him a host of friends wherever he was engaged. Those who profited by his guidance will long remember his generous and encouraging spirit.

ALFRED J. LOTKA

THE NEW WHEAT CONDITION FIGURES, BASED ON WEATHER FACTORS, FOR THE PRAIRIE PROVINCES REJOINDER

By F. H. Sanderson
Harvard University

In the December 1942 issue of this Journal, the writer undertook an analysis of the recent shift by the Bureau of Statistics of the Dominion of Canada from wheat condition figures based on crop correspondents' returns to "condition figures" based on a statistical study of weather-yield relationships.[1] The writer compared the two series and reached the conclusion that the new series may be expected to be less reliable than the old, instead of being at a 7:3 advantage as the Bureau had maintained. It was also pointed out that a combination of reported condition and weather data gave results superior to the use of either series alone.

Limitations of space preclude a full analysis of Dr. Wilson's reply. His central thesis, that the regression method of interpreting condition figures is not applicable to short-season crops like spring wheat, is certainly untenable. Dr. Wilson admits that this method has yielded satisfactory results in forecasting long-season crops like winter wheat in the United States. But our spring wheat crop, the greater part of which is grown in the Dakotas and Montana under conditions similar to those prevailing in the Prairie Provinces, has been predicted from reported condition with even greater success, as measured by the correlation coefficient, than winter wheat.

It seems, however, that on this particular point Dr. Wilson is not prepared to accept empirical evidence—excepting, perhaps, the July 31 report. Regardless of the "statistical"[2] significance of the results, he thinks that it is "logically futile" to try to predict the yield of spring wheat prior to July 31, because the "major determinants of yield are not on record" before this date.

This statement is not borne out by the facts. An analysis made by this writer shows that in the Dakotas and Montana, the preseasonal and spring precipitation up to May 31 accounts for more than 50 per cent of the variations in spring wheat yields. It is, therefore, not surprising that the reported condition as of May 31 does often supply a fairly reliable basis for forecasting yield. Weather conditions during June are important, however. A careful study, by means of a "regression integral," of spring wheat yields at Dickinson, N. D., indicates that

[1] This Journal, Vol. 37, No. 220, December 1942, pp. 473–483.
[2] Dr. Wilson's quote marks.

the crop reaches its maximum susceptibility with respect to rainfall about June 20. By June 30, the major determinants of yield are on record.[3]

In view of the relationships known to exist between weather conditions early in the season and spring wheat yields, and considering the rather high correlations found, it is difficult to see the "logic" in Dr. Wilson's refusal to "attach significance" to the earlier reports. But it is on these "logical" grounds that Dr. Wilson rejects any evidence based on the May 31 and June 30 reports and that he believes himself justified in confining his discussion to a comparison of the results for July 31. This is the more puzzling as he evidently did attach significance to the earlier reports when his office shifted from the old to the new method. In explaining the reasons for the change, the 7:3 ratio was derived on the basis of a comparison of the May 31, June 30 and July 31 reports. It may be added that to the users of crop reports, the earlier reports are just as important as the July 31 estimate.

If the method suggested by this writer as a means of improving the old-style condition figures has any merit, it lies in the fact that it increases the reliability of the earlier forecasts. However, this approach is set aside by Dr. Wilson largely on the same grounds as the regression methods in use in the United States Department of Agriculture. In addition, he questions the choice of weather factors used for the adjustment of condition figures. He concedes that it is logical to assume that soil moisture reserves are generally neglected by crop correspondents in their earlier reports, but holds that this additional variable is "subject to question" in the later reports, since correspondents "would have visual evidence of any significant differences" soil moisture reserves have made. The results of the writer's condition-and-weather analysis are in complete agreement with Dr. Wilson's reasoning. The relative importance of the factor "preseasonal precipitation" as a determinant of yield diminishes rapidly as the season advances.

Davis' and Pallesen's regression integral shows that the crop reaches its maximum sensitivity to rainfall about June 20, when an additional inch of rain would lead, on the average, to an increase in yield of four bushels per acre. After heading (which occurs about July 10), the beneficial effect of rain decreases sharply and reaches zero about July 20. Consequently, it is not at all illogical to find that the inclusion of weather conditions during the ten days preceding the June 30 report leads to a significant improvement in the correlation between reported condition and yield, whereas no such improvement results in the case of the July 31 report.

[3] See F. E. Davis and J. E. Pallesen, "Effect of the Amount and Distribution of Rainfall and Evaporation during the Growing Season on Yields of Corn and Spring Wheat," *Journal of Agricultural Research*, Vol. 60, No. 1, January 1, 1940, pp. 1–23.

With regard to the July 31 report, Dr. Wilson is now willing to accept the regression method of interpreting reported condition. In an attempt to prove that even on this basis the new series is superior to the old, he excludes from consideration two years in which, he holds, "extraneous factors" were dominant. It so happens that his two largest errors of estimation fall in these two years. In one of these years, "extensive rust damage" was reported, but the same is true of other years which were not omitted. The exclusion of the other year could not even be supported by a qualitative indication of "extraneous" damage. This observation was omitted "because of the extremely abnormal distribution of rainfall in June and July": after a long period of drought, heavy rain fell in the last few days of July, too late to repair the earlier damage. Dr. Wilson does not say how his formula will enable him to make allowance for such "abnormalities" when they occur again in the future. It is precisely one of the principal weaknesses of the conventional weather-crop analyses that they are not sensitive to variations in the distribution of rainfall, etc., *within* the broad periods which serve as time intervals. The two-months period (June-July) used by Dr. Wilson contains a period of maximum sensitivity of the plant with respect to rainfall (about June 20), as well as a period in which the effect of rainfall is zero (the end of July).

A FURTHER REPLY

By C. F. Wilson
Dominion Bureau of Statistics

Two points of fact and a question of procedure arising from Mr. Sanderson's Rejoinder prompt this further reply.

The first point of fact is raised in Mr. Sanderson's statement that the spring wheat crop of the Dakotas and Montana is grown "under conditions similar to those prevailing in the Prairie Provinces." This comparison is inadequate to the point of being incorrect. Within the Prairie Provinces themselves there is at least a five-week range in the dates of harvest; on the average the harvest is three weeks behind that of the Dakotas and Montana. Accordingly, the Davis-Pallesen regression integral indicating the maximum susceptibility of the crop to rainfall around June 20 at Dickinson, N. D., would suggest a corresponding period of maximum susceptibility in the Prairie Provinces around the end of the first week in July. This is quite in keeping with my thesis that the major determinants of yield in the Prairie Provinces are not on record in time for dependable forecasts of final yield to be made as of May 31 and June 30. Analyses at these dates are logically consistent only so far as they appraise the crop progress to date. The importance of July temperatures, in addition to rainfall, emphasizes this conclusion.

The second point of fact arises from Mr. Sanderson's concluding remark that the June-July period in my analysis "contains a period of maximum sensitivity . . . (about June 20) as well as a period in which the effect of rainfall is zero (the end of July)." As already indicated, the June 20 Dickinson, N. D., date would fall around July 5–10 for the Prairie Provinces, where the plant which is headed and filling toward the end of July is very considerably benefited by rainfall during that period. The only condition under which the effect of end-of-July rainfall is zero would be that in which the plant had already collapsed from drought.

This leads to the question of procedure raised by Mr. Sanderson's criticism of my exclusion of the 1937 data from the Alberta analysis, because collapse from drought had occurred. The answer to Mr. Sanderson is that when this happens in the future, rainfall following collapse would properly be excluded from the data. Had this been done in the analysis, and the 1937 observation included, the resulting test of significance might have been improved. In any event, the effect of the exclusion (rather than adjusting the data) of that observation on the appraisal of the analysis is small in comparison with the effect of Mr. Sanderson's exclusion from his analysis of the whole record for Manitoba, and the years 1938, 1939 and 1940 for Saskatchewan and Alberta. Only by such exclusion could he arrive at the conclusion reiterated in the opening paragraph of his Rejoinder that his combination of reported condition and weather data gave results superior to mine. Even with his exclusions, my results were superior in Manitoba and Alberta; without his exclusions, my results were superior in Saskatchewan as well.

CONCLUDING REMARKS

BY F. H. SANDERSON

The two points of fact raised by Dr. Wilson resolve themselves into one. He holds that in applying the findings of Davis' and Pallesen's study to Saskatchewan and Alberta, allowance must be made for a lag of three weeks in the progress of the crop between Dickinson, N.D., and the Prairie Provinces.

The writer anticipated this objection. Before making his statement, he took the precaution of consulting five specialists in the area, professors of field husbandry and experts at representative experiment stations ranging from Saskatoon to Edmonton and Lethbridge. All five agreed that the average date of heading of spring wheat throughout this region is practically the same as at Dickinson, namely about July 10. The writer's conclusions are therefore fully applicable to the two Prairie Provinces.

The point which emerges most clearly from Davis' and Pallesen's study is precisely that the critical period is centered about three weeks prior to heading and that the beneficial effect of rainfall during the filling stage is negligible.

Dr. Wilson's concluding remark is partly incorrect[1] and partly unsubstantiated.[2] The issues are now squarely before the reader. In his original statement, Dr. Wilson has contended that the new wheat condition figures, based on his weather-yield analysis, are at a 7:3 advantage over the condition reports previously obtained from crop correspondents. To substantiate his contention, Dr. Wilson (1) adjusts the reported condition figures, thereby reducing their reliability as indicators of final yield; (2) excludes certain observations from his weather-yield analysis; (3) discards the regression method of interpreting condition; (4) disregards the possibility of adjusting condition for the lag-effect of certain weather factors. Yielding on one point, he then accepts the regression method as a yardstick for the July 31 report, but rejects any evidence based on the May 31 and June 30 reports. It seems that in his discussion, Dr. Wilson has not substantiated the validity of these procedures.

EDITOR'S NOTE.—After a year of correspondence between the parties involved, the Editor has found it necessary to terminate this discussion by arbitrarily limiting further argument to about four pages and allocating this space in the above proportions.

Two points of disagreement remain.

Dr. Wilson has requested inclusion of the following data secured from the official records of nine Dominion Experiment Stations showing the average dates of first cutting over the past sixteen years:

Morden, Manitoba	Aug. 4	Swift Current, Saskatchewan	Aug. 13
Brandon, Manitoba	Aug. 15	Beaver Lodge, Alberta	Aug. 28
Indian Head, Saskatchewan	Aug. 22	Lacombe, Alberta	Aug. 31
Rosthern, Saskatchewan	Aug. 21	Lethbridge, Alberta	Aug. 8
Scott, Saskatchewan	Aug. 22		

Mr. Sanderson counters with a statement that these data are not relevant, there being considerably greater dispersion in the average dates of harvest than in the average dates of heading, and takes further exception to Dr. Wilson's interpretation of these data. There seems no way of reaching an early agreement on this point.

The second center of disagreement regards Mr. Sanderson's first numbered point in the final paragraph of his Concluding Remarks. Mr. Wilson writes "... no adjustment whatever was made in the reported condition figures in that comparison." It does not appear from Mr. Sanderson's correspondence that this statement is accepted by him. It would seem that they are not talking about the same comparison.

The value of a discussion of this sort lies in the advancement of scientific procedures. The Editor believes that only the test of time and actual future experience can put a period to this discussion.

[1] Compare this JOURNAL, December 1942, Table IV, page 492.

[2] Manitoba accounts for only 13 per cent of the Canadian wheat crop; the inclusion of this province would therefore make little difference in the total result.

REPORTS OF THE ASSOCIATION

Report of the Board of Directors

The activities of the American Statistical Association during 1943 have been for the most part of the sort described in military communiques as a "holding action." A little ground gained here, a little lost there, a situation at the year's end much like that at its beginning. The Nation's preoccupation with winning the war and laying the groundwork for the eventual peace was reflected in the concentration of the Association's members on their individual contributions to those objectives. Of necessity, these priorities have greatly reduced the time and energy available for the Association's activities as such. The Association's long-range, continuing projects and much of its internal program have temporarily been held in abeyance pending the day when it is again possible to pick up the threads of peacetime living.

At the same time that the Association has deemed it appropriate to curtail many of its own immediate projects and plans, statistical activity in this country has reached new levels of intensity and importance. Urgent problems of manpower utilization and draft, of materials allocation and supply, of munitions requirements, scheduling and production; tremendous readjustments in our national economy, in its economic, business and social organization; enormous demands upon all the physical and natural sciences for discovery and development at unprecedented rates—these problems in their many ramifications have all presented a great challenge to statisticians. The challenge has been and is being met. The Association may take pride in the role played by members of the statistical profession in the Nation's war effort.

Because of the cancellation of the 1942 Annual Meeting it was impossible for the Association to follow its customary procedure in the election of its officers for 1943. The Association's Constitution provides that "the Board of Directors shall fill vacancies in any office and in its own membership until the next Annual Meeting." With that provision as its authority, the Board of Directors at its first meeting in 1943 accepted the resignations of the 1942 officers and of the Directors whose terms should have expired at the Annual Meeting in 1942, and appointed to the vacant offices the candidates proposed by the Nominating Committee.

As in 1942, your officers have responded to the increased transportation emergency by foregoing a national Annual Meeting. The following summary of the Association's work and general welfare, customarily presented at that meeting, outlines the activities which, even in a period of retrenchment, have been carried on during 1943.

The Chapters. The activities of the Chapters during the year have evidenced a recognition of the increased responsibility of those groups for

furthering the Association's program. Statistics in the various phases of war activity, and in relation to anticipated postwar problems, have afforded the material for much extremely worth while Chapter discussion. Regional meetings, in place of a national Annual Meeting, under the auspices of the respective local Chapters are being planned in New York City, Washington and Chicago. An active new Chapter has been established in Denver.

Several of the Chapters have initiated or continued programs for appraising state and local statistical work, and others have sponsored special short courses in new methodological developments, especially in the control of quality in production. Other groups of Association representatives and members in several sections of the country, although not under the sponsorship of any particular chapter, have also been active in conducting seminars and short courses in quality control with particular reference to munitions production.

The Biometrics Section. A meeting of the Biometrics Section was held in Columbus, Ohio, during February. Financial support for this meeting was contributed by the Division of Biology and Agriculture of the National Research Council. Held in conjunction with a meeting of phytopathologists concerned with war problems, the conference was attended by entomologists, phytopathologists and biometricians. Its program was centered around a collaborative study of the more efficient use of war-scarce insecticides and fungicides. A memorandum describing research needs, developed at this conference, was later distributed in mimeographed form with the cooperation of the Connecticut Agricultural Experiment Station, and received widespread attention. Other activities of the Section during the year were directed toward the planning of meetings with other groups of scientists, some of which it is hoped may be held in 1944.

Pressure of war work necessitated the curtailment of much of the Association's committee activity, but several committees have functioned effectively during the year.

Census Advisory Committee. The Census Advisory Committee met in January, April and August for two-day meetings. At the January meeting, the Committee reviewed the programs of the Bureau of the Census brought into prominence by wartime needs for statistical data. These included the extension and development of statistics on foreign trade, basic materials, business, industry and governments. The current manufactures reports program was of special interest because of the needs of the war production program. Main emphasis at the April meeting was upon the Census of Agriculture scheduled for 1945, and upon problems involved in conducting this census under wartime conditions. It was the consensus of the Committee that more careful study should be given to general census plans before making specific recommendations concerning a number of important questions relating to the agriculture census. The August sessions were devoted primarily to a consideration of the over-all program of the Bureau with emphasis on wartime and postwar statistics.

After consideration of all phases of the Census program the Committee adopted a resolution urging the Director "to exert every effort to obtain authorization and funds for the initiation of the Census Bureau's statistical reporting program designed to provide business, industry, labor and government with basic information on a current basis for war and postwar purposes." The Committee stated that in its judgment the expenditure required for the initiation and maintenance of an adequate statistical reporting program would represent a sound national investment, the lack of which will be infinitely more costly in terms of economic and human resources.

At all three meetings vital records and vital statistics were discussed as a continuation of the discussions at the meetings of the previous year. At the January meeting a progress report was made on the problem of National Population Registration and Vital Records. The Advisory Committee of the Census passed a resolution favoring the strengthening of the existing vital records organization of the country at national, state, and local levels. By the time of the April meeting of the Committee, a report of the Commission on Vital Records had been made. The Census Advisory Committee had occasion to disagree with the recommendation of the Commission and passed a resolution recommending that "in the formulation of an extended vital records program the Bureau of the Census continue as the agency responsible for developing and compiling vital statistics whether or not the responsibility for the entire vital records program is placed in that Bureau." By the time of the August meeting a report had been made by the Bureau of the Budget recommending again the inclusion of both vital records and vital statistics in a vital records office placed in the Public Health Service. Although the Committee did not feel that this report offered the best solution, no further action was deemed necessary at this time.

Committee on Census Enumeration Areas. Correspondence with committee members and key persons in various census tract cities has continued throughout the year. The program of the Committee for the immediate future includes two principal objectives: (1) further to inspire individuals located in each census tract city to use census tracts more fully in the solution of the various problems involving the life of the community, and (2) to extend each area already laid out in census tracts to include the entire community as well as the central city.

Joint Committee on Occupational Classification. This Committee's technical subcommittee on clearance of new titles incorporated in the United States Employment Service Occupational Dictionary has continued its functions. Members of the Committee have also served on a technical subcommittee of the Bureau of the Budget which has proposed a tentative occupational classification for the reporting of employees in the Executive Branch of the Federal Government. This classification is, in general, convertible to the Convertibility List of Occupations adopted by the Committee in 1939, and will permit comparisons of the occupational distribution of workers in the Federal Government and in private employment.

Committee on the Bureau of Labor Statistics' Cost of Living Index. In May,

the President of the Association, at the request of the Department of Labor, appointed a special committee to review and appraise the construction and uses of the Bureau of Labor Statistics' Cost of Living Index. This Committee, working with its own technical assistants and the cooperation of the Bureau, presented its report to the Secretary of Labor a few months later. The report has had a wide distribution, and has been published in full in this JOURNAL.

Other Committees and Representatives. At the request of the Foundation for the Study of Cycles, an Advisor from the Association was appointed to that organization.

Through its representatives, the Association also participated in the work of the Social Science Research Council, the National Bureau of Economic Research, the American Association for the Advancement of Science, the Advisory Board of the *American Year Book*, the Advisory Committee to the Census Library Project and the American Documentation Institute.

During the year the Joint Committee on Relief Statistics, the Advisory Committee on Morbidity Statistics and the Advisory Committee to the National Roster of Scientific and Specialized Personnel were discharged with the appreciation of the Association.

Publications. Quarterly issues of the JOURNAL and BULLETIN were published during the year. A number of papers scheduled for presentation at the cancelled 1942 Annual Meeting were printed in various issues of the JOURNAL. Departing from traditional procedure, the report of the special Committee of the Association on the Cost of Living Index of the Bureau of Labor Statistics, referred to above, was made available as a preprint considerably in advance of its appearance in the December issue of the JOURNAL. Short articles of particular timeliness on statistical training in connection with war programs were published in the BULLETIN.

Membership and Finances. During 1943 there was a continuation of the downward trend in the Association's membership from its high point in 1941. Although the total number of names removed from the membership list for reason of death, resignation or failure to pay dues was slightly lower than in 1942, the number of new members joining during the year was also smaller than in the preceding year, resulting in a net decrease of approximately 150 in the membership of the Association.

Income from dues during the year necessarily reflected the losses in membership, falling almost $1,000 below the amount of such income in 1942. Income from JOURNAL advertising and the sales of back issues of the JOURNAL also fell below the figures for the preceding year. However, through reductions in total wages and salaries, stringent economies in office expenditures, reductions wherever possible in other items of expense, and the generosity of the American University in providing the Association with office space during the first half of the year, the Association closed the year with an excess of receipts over expenditures of more than $1,000. No funds were withdrawn from the Centenary Sustaining Fund. The balance in this fund at the close of the year was $5,670.81.

Outlook for the Future. Events are moving swiftly as this report is written in the last days of 1943. By the time that it appears in print, military actions may have provided an indication of how much longer our country is to be at war. But whether that period is to be a long or a short one, the tremendous problems beyond the day of armistice are already deeply foreshadowed. In the period of continued readjustment that lies ahead for the Nation, the questions posed the statistician will continue to be on matters of the deepest import for the national welfare.

Your officers feel that the Association must not continue to pursue too long the policy of retrenchment and curtailment which has for the past two years seemed its wisest course. The implications of the membership trend are not necessarily only that the war has taken a toll. Opportunities for effective service and leadership must not be passed by. New fields of subject and of method have been developed during these war years. If the Association is to have a real part in making them most productive in the postwar peace, it must prove its adaptability and its vision.

HENRY B. ARTHUR
THEODORE H. BROWN
E. A. GOLDENWEISER
F. LESLIE HAYFORD
LESTER S. KELLOGG
SIMON KUZNETS
WALTER A. SHEWHART
FREDERICK F. STEPHAN

Report of the Secretary

During 1943 the total membership of the Association declined from 3,037 to 2,883, a net loss of 154 members. During the year, 189 new members were elected and 20 former members were reinstated. One hundred and forty-two members resigned; 207 members were removed from the active rolls for failure to pay dues; and 14 members were lost by death during the year, including two Fellows. By the end of the year, 161 members had reported to the Association that they were privates or non-commissioned officers in military service, and at least 75 members were commissioned officers.

The death of the following members was recorded during the year: Edward L. Dodd and Horace Secrist, *Fellows;* S. Chapman and George H. Van Buren, *Senior Members;* Paul T. Cherington, Roy E. Dennis, William Eckerstrom, David P. Haber, Robert Henderson, Joseph C. Rocca, Giles M. Ruch, Mark A. Smith, Richard B. Smith and Madeline Tregaskis, *Regular Members.*

Membership Statement, December 31, 1943

Honorary members	14
Corporate members	4
Fellows	117
Regular members	2,748
Total membership	2,883

One Fellow was a Contributing Member during 1943. Two new Life Members were elected during the year, bringing the total number of Life Members to 39.

LESTER S. KELLOGG, *Secretary*

Report of the Committee on Fellows

During 1943 the Committee on Fellows elected ten members of the Association to Fellowship. This was in accord with earlier decision by the Association that the number of Fellows should be slowly increased toward a maximum of one hundred and fifty. Those elected this year were:

Thomas C. Atkeson, *U. S. Bureau of Internal Revenue*

Merrill K. Bennett, *Food Research Institute*

Arthur F. Burns, *National Bureau of Economic Research*

Cecil C. Craig, *University of Michigan*

Churchill Eisenhart, *University of Wisconsin*

George B. Roberts, *National City Bank of New York*

Richard E. Scammon, *University of Minnesota*

Arthur R. Tebbutt, *Northwestern University*

George Terborgh, *Machinery and Allied Products Institute*

Holbrook Working, *Food Research Institute*

At the beginning of 1943 there were one hundred and nine living Fellows. During the year two died.

W. L. CRUM, *Chairman*

Report of the Treasurer

During 1943 the Association's income from regular sources totalled $18,347, a decrease of almost $1,300 from the 1942 figure. Almost $1,000 of the decrease was accounted for by the decline in membership and consequent lower revenue from dues. Subscriptions, which dropped considerably in 1942, improved slightly during 1943.

Because of the necessity which arose in June for moving the Association's office from the American University to its present location, an unbudgeted expenditure of $375 for rent was incurred. The increase in 1943 over 1942 of $177 for office supplies, printing and mimeographing was due to payment of $256 for printing which ordinarily would have been paid in 1944. On a strictly comparable accounting basis the 1943 total for this item is $79.30 less than in 1942. "Miscellaneous expense" includes an unbudgeted expenditure of $149.27 incurred in moving the office. Practically all other items of expense showed substantial reductions from the corresponding 1942 figures. The major decrease, as mentioned in the *Report of the Board of Directors*, was effected in salaries and wages, which were reduced more than $1,400. This saving resulted from a reduction in personnel made possible by longer hours and the assumption of greater responsibilities by staff members. The cost of the BULLETIN was reduced by almost $350 from 1942.

In spite of unbudgeted expenses, the total expenditures of the Association were reduced more than $1,900 in 1943. Notwithstanding losses in income, the result of this curtailment was an excess of income of more than $1,000 which was carried to surplus at the end of the year.

No funds were appropriated from the Centenary Sustaining Fund during the year. Withdrawals from this fund were made in 1940 and 1941, but none has been made in 1942 or 1943. The total of $5,670 now in the fund, which will be further increased by final payments pledged for 1944, may provide the financial basis for a resumption of expanded Association activities.

The balance sheet and other detailed financial statements, with comparisons for 1942, are included in the Report of the Auditors.

LESTER S. KELLOGG, *Treasurer*

Report of the Auditors

To the Board of Directors of
American Statistical Association

We have examined the balance sheet of the American Statistical Association as of December 31, 1943 and the statements of income and surplus for the year then ended. Our examination was made in accordance with generally accepted auditing standards applicable in the circumstances, and included such tests of the accounting records and other supporting evidence and such other procedures as we considered necessary.

The recorded cash receipts for the year were traced to the deposits shown on the bank statements and the amounts for dues and subscriptions were tested with the membership and subscription records. The paid checks and relative vouchers were inspected in support of the cash disbursements for the year. The cash balances and the securities owned at December 31, 1943 were confirmed by inspection or by certificates obtained direct from the depositaries. We did not check the membership and subscription records in detail or make any independent verification of the inventory of old journals, the office records of which are based in part on data assembled in prior years, no recent physical inventory having been taken.

The life membership reserve is computed on the basis of the combined annuity table of mortality with assumed interest at 4% per annum and an assumed annuity of $5.00 per life member, in accordance with a resolution of the Board of Directors on March 31, 1936. The amount treated as income in each year represents the excess of the reserve at the beginning of the year plus interest for the year and new life membership receipts over the required reserve at the end of the year.

In our opinion, the accompanying balance sheet and related statements of income and surplus present fairly the position of the American Statistical Association at December 31, 1943 and the results of its operations for the year, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

PRICE, WATERHOUSE & CO.

Washington, D. C.
March 11, 1944

AMERICAN STATISTICAL ASSOCIATION

BALANCE SHEET

Assets	December 31, 1943	December 31, 1942
Cash in bank and on hand	$ 7,599.72	$ 6,547.86
Accounts receivable	542.85	262.84
Investments:		
United States Savings Bonds, Series D, at redemption value	5,481.00	5,320.00
Stocks, at cost (at market quotations $4,460. and $4,125, respectively)	5,793.50	5,793.50
Inventory of old Journals, at approximate cost	1,668.70	1,655.58
Furniture and equipment, at cost less depreciation	417.04	479.49
Deferred charges (expenses applicable to subsequent year)		255.57
	$21,502.81	$20,314.84

Liabilities		
Accounts payable	$ 1,345.65	$ 1,491.30
Centenary Sustaining Fund, per statement	5,670.81	4,802.97
Life membership reserve	2,455.68	2,341.53
Deferred credits (collections applicable to subsequent year):		
Dues	3,533.07	4,753.67
Subscriptions	2,097.50	1,572.67
Contributions		41.00
Surplus, per statement	6,400.10	5,311.70
	$21,502.81	$20,314.84

AMERICAN STATISTICAL ASSOCIATION
INCOME STATEMENT

	Year ending December 31, 1943	1942
INCOME:		
Dues—current year	$12,775.00	$13,765.50
Dues—prior years	130.50	70.00
Life memberships	179.51	166.89
Subscriptions	3,352.50	3,277.25
Advertising	656.83	950.19
Reprints	617.48	404.50
Journal sales	306.65	635.75
Index to the Journal, sales	12.00	23.50
Special publications	46.97	63.76
Miscellaneous	67.75	110.95
Dividends and interest (after deducting $92.63 in 1942 and $93.66 in 1943 apportioned to life membership reserve)	197.42	164.79
	$18,342.61	$19,633.08
EXPENSES:		
Journal—printing, mailing and reprints	$ 4,685.56	$ 4,852.81
Bulletin	381.79	726.95
Salaries and wages	9,699.14	11,111.07
Unemployment compensation tax	110.60	233.40
Rent	372.17	
Office supplies, printing and mimeographing	646.81	470.11
General postage and carriage	435.62	454.40
Telephone and telegraph	188.31	141.43
Travel expense—officers	253.85	246.49
Mimeographing—committees		41.09
Storage of old Journals	72.00	72.00
Cost of old Journals, sold	26.88	204.33
Miscellaneous expense	295.88	307.58
Depreciation of furniture and equipment	73.60	84.62
Survey of defense statistics		325.32
	$17,242.21	$19,271.60
Excess of income over expenses, carried to surplus	$ 1,100.40	$ 361.48

AMERICAN STATISTICAL ASSOCIATION
SURPLUS STATEMENT

	Year ending December 31, 1943	1942
Balance at beginning of year	$ 5,311.70	$ 4,973.72
Add—Excess of income over expenses for the year, per income statement	1,100.40	361.48
	$ 6,412.10	$ 5,335.20
Deduct—Appropriation to Centenary Sustaining Fund of amount equal to net proceeds from sales of Index to the Journal	12.00	23.50
Balance at end of year	$ 6,400.10	$ 5,311.70

STATEMENT OF CENTENARY SUSTAINING FUND

	Total	Year ending December 31, 1943	Prior to 1943
Contributions and pledges (relating to the support of the activities of the Association for a period of five years from January 1, 1940 to December 31, 1944)	$10,686.02		
Less: Pledges not collected at December 31, 1943 including $582.50 not due at that date	960.00		
Amounts received from contributors	$ 9,726.02	$756.25	$8,969.77
Interest received on bank savings account and increase in redemption value of securities	331.17	99.59	231.58
Appropriation from surplus of amount equal to net proceeds from sales of Index to the Journal	390.15	12.00	378.15
Total receipts	$10,447.34	$867.84	$9,579.50
Less: Expenses of campaign (printing, postage and temporary assistance)	776.53		776.53
Net receipts	$ 9,670.81	$867.84	$8,802.97
Appropriations by the Board of Directors to the general account of the Association in accordance with the budget: Year 1940 ... $1,500.00; Year 1941 ... 2,500.00	4,000.00		
Balance December 31, 1943, per balance sheet	$ 5,670.81		

List of Committees and Representatives for 1943

Committee on Fellows[1]

W. Leonard Crum
John Rice Miner
Theodore H. Brown
Lowell J. Reed
Joseph S. Davis

Committee on Nominations

F. Leslie Hayford, *Chairman*
F. L. Carmichael
Douglas E. Scates

Committee on Investments

F. Leslie Hayford, *Chairman*
George O. May
Walter W. Stewart

Biometrics Section Committee

C. I. Bliss, *Chairman*
Churchill Eisenhart, *Secretary*
Alva E. Brandt
William C. Cochran
Gertrude M. Cox
Alfred J. Lotka
Hugo Muench, Jr.
J. Neyman
Lowell J. Reed
George W. Snedecor

Census Advisory Committee

William F. Ogburn, *Chairman*
Murray R. Benedict
Paul T. Cherington*
J. Frederic Dewhurst
Luther Gulick
Frederick F. Stephan
Willard L. Thorp

Committee on Census Enumeration Areas

Howard W. Green, *Chairman*
Clarence E. Batschelet
W. Thurber Fales
Ernest M. Fisher
Shirley K. Hart
Charles S. Newcomb
Vergil D. Reed
Leon E. Truesdell
Lent D. Upson

Joint Committee on Occupational Classification

Gladys L. Palmer, *Chairman* and *Secretary*
E. Dana Durand
Meredith B. Givens
Edward D. Hollander
Merrill G. Murray
Leon E. Truesdell
Emmett H. Welch

Committee on Chapters

Henry B. Arthur, *Chairman*
Edwin B. George
Lester S. Kellogg
William A. Sturm
Charles W. Vickery, Jr.
Robert R. Williams

[1] With terms expiring at the end of 1943, 1944, 1945, 1946, and 1947, respectively.
* Deceased.

Committee on Sampling

Frederick F. Stephan, *Chairman*
W. Edwards Deming
George W. Snedecor
Alfred N. Watson
Samuel S. Wilks
Theodore O. Yntema

Budget Committee of the Board of Directors

F. Leslie Hayford, *Chairman*
Frederick F. Stephan
Walter A. Shewhart

Committee on Problems Relating to Sections

F. Leslie Hayford, *Chairman*
C. I. Bliss
Lowell J. Reed
Walter A. Shewhart

Representative on the Board of Directors of the National Bureau of Economic Research

Frederick C. Mills

Members of the Social Science Research Council[1]

Edwin B. Wilson
O. C. Stine
Frederick F. Stephan

Representative on the Council of the American Association for the Advancement of Science

Walter A. Shewhart

Representatives on the Joint Committee for the Development of Statistical Applications in Engineering and Manufacturing

Walter A. Shewhart
Churchill Eisenhart

Representative on the Sectional Committee on Standards for Graphic Presentation

A. H. Richardson

Committee to Advise the Bureau of Labor Statistics on Its Cost of Living Index

Frederick C. Mills, *Chairman*
E. Wight Bakke
Samuel Stratton
Reavis Cox
Theodore W. Shultz

Member of the American Documentation Institute

Richard L. Funkhouser

Representative on the Advisory Board of the American Year Book

Frank W. Notestein

Representative on the Advisory Committee to the Census Library Project

Richard O. Lang

Advisor to the Foundation for the Study of Cycles

W. Edwards Deming

[1] With terms expiring at the end of 1943, 1944, and 1945, respectively.

BOOK REVIEWS

GLENN E. McLAUGHLIN, *Review Editor*

Redirecting Farm Policy, by Theodore W. Schultz. New York: The Macmillan Company. 1943. vii, 75 pp. $1.00.

This germinating little book is excellent in title and quietly revolutionary in content. Its penetrating criticisms and constructive ideas amply merit pondering in their bearing on public policy, even beyond the realm of agriculture.

The author seeks basic, comprehensive "economic directives" to coordinate otherwise conflicting programs and to guide "(a) the use of resources, and (b) the size, distribution, and use of incomes of farm people, and (c) the distribution of the food supply among consumers in such a way as to serve the general interest best."

Serious weaknesses in parity concepts and formulas are brought out. Taking parity prices as ends has led to "a crisis in agricultural policy centering on prices." "Prices must be seen and employed as economic directives and not as goals." In peace or war, deflation or inflation, prices are "by all odds the most basic and far-reaching administrative technique yet devised for directing and coordinating both the production and distribution of the food supply." But they must be flexible and "forward-looking," not tied to the past and into the future, as legislative formulas now tie them.

Improving the management of agricultural resources and improving farm income and its distribution are essentially distinct objectives, not identical or closely interlinked as commonly assumed. The author makes positive proposals toward both.

On the production side, he urges extensive use of production goals and "forward prices," designed to keep farm production in line with food needs and to minimize economic uncertainty in farming. He argues for "administering" prices of farm products in such ways that farmers would know, before the beginning of each production period, what they could count on getting for what they produce in that period. He favors various auxiliary devices: official stockpiles, flexibly built and used to even out the results of miscalculation and vagaries of the weather affecting supply; equalization funds, "one for each of the various clusters of farm commodities," to make adjustments for unpredictable variations in demand; and subsidized surplus disposal.

On the income side, the author's proposals are limited but not cautious. Implicitly approving supplementing farm incomes, in accordance with "social welfare criteria," he suggests four rules: (1) avoid making grants-in-aid according to production, for such tend to be regressive; (2) make grants not in cash but in kind—food, housing, medical care, education, etc.; (3) make them available on equal terms to all families, regardless of their income

status; and (4) tie the supplemental income to the farm family, the home, and consumption, not to property resources or the farm as a business concern.

"The difficulties in the use of the forward price technique are primarily in the political sphere." Such difficulties are vastly larger than the author appears to admit. Considering political forces, pressure groups, and bureaucratic limitations of various kinds, I see far less practical scope for wise use of administered prices, supplemental devices, and income subsidization than the author's scheme entails—especially for times of peace.

JOSEPH S. DAVIS

Food Research Institute
Stanford University

Food Enough, by John D. Black. Lancaster: The Jacques Cattell Press. 1943. vii, 269 pp. $2.50.

The title of this book is short and relatively simple, but its subject matter concerns the complicated task of growing enough food of the right kinds and getting it in the necessary proportions with proper timing to our armed forces, our war workers, and our civilian families, as well as doing our share toward feeding our allies and the people of freed nations. The central generalization of the book is to the effect that "no *physical* reasons exist why food enough cannot be produced, processed, and moved into consumption" for such purposes. If this objective is not reached, "the reasons will not be physical, except as bad weather may be a factor in it. They will be *human*," and will relate to inadequacies in the order and organization of the task.

First claim on the food produced is rightly given to the armed forces, but questions are raised as to the efficiency with which the task is being done. The author feels that our war plant workers are not being properly fed, and that the war effort is definitely retarded on account of the fact. With regard to feeding the civilian population of this country, "the division of purposes between producer and consumer, and agriculture and labor, and distributors and the public must cease." There is not enough information available to distribute intelligently the food available to our allies and other friendly nations under lend-lease. The food situation in Germany, at least so far as the military is concerned, is not critical. The chief deficiency is in fats and oils.

A number of conclusions in the book will not meet favor with the farmers generally nor with the "farm bloc." Farm income, except in restricted areas of the economy, is viewed as fully adequate, at least under present conditions; farm manpower is sufficient for production needs *if* properly distributed; subsidies are viewed with a rather favorable eye; and the "parity" concept should be banished for the war period at least.

The book is well worth the time of the person who would like to have a comprehensive picture of our food problems. It is not popular reading, for although the author is an able thinker, his books generally are viewed as

difficult in style, and the present one is no exception. Another criticism is the unavoidable one that so accelerated is the present pace of social change that some parts of the book are already out-of-date and many new materials deserve inclusion.

Wilson Gee

University of Virginia

The World Coffee Economy with Special Reference to Control Schemes, by V. D. Wickizer. Stanford University: Food Research Institute, Stanford University. 1943. x, 258 pp. $3.00.

This is an indispensable reference work for the coffee student. It presents a wealth of material in an orderly manner. It is particularly effective in bringing out the inertia of demand, the extreme variability of supply, and the extra hazards of political expedients. It leaves one questioning whether the tremendous forces of economics and psychology can be controlled by man-made devices.

In his discussion of the Inter-American Coffee Agreement the author indicates rather clearly that generosity, even with the best intentions, should be tempered with canniness. If the United States consumer should refuse continued acquiescence in having the cost of his favorite matutinal beverage forced upward (for example, by minimum export prices in Colombia and Brazil), how much gratitude will remain for his previous complaisance? Rigging the market, moreover, is costly for the producer in the long run as well as for the consumer.

The judgments expressed are discriminating, for instance, the implication that if production continued to expand in Colombia over a period of eight years the prices prevailing during that period must have been reasonably encouraging.

Some other virtues deserve special mention, such as the statistical chart inside the cover. On the other hand, certain readers may feel that a few matters could have been handled better. This reviewer would prefer to have all tables adequately explained in their own headings rather than in the text of the preceding paragraph. The book is written in a good, clear, readable style, but is sometimes irksome from the writer's unwillingness to trust the reader's imagination.

The least satisfying part of the study is its discussion of production costs. The investigator could have found in United States consular reports better and later data than he used. Brazilian fazenda reactions to various sacrifice quotas indicated a cost base generally below a milreis a kilogram instead of considerably higher.

The author undoubtedly realizes the incomplete value of the statistics available. For reasons that were presumably adequate he does not warn the reader that some crop years date from July first and others from October first; that the time lag is important in comparing export and import statis-

tics; that exchange regulations make price records difficult to interpret. Such criticisms, however, seem unimportant in face of the thoroughness of Mr. Wickizer's work and the evident resourcefulness of the Food Research Institute.

CAROL H. FOSTER

Washington, D. C.

World Trade in Agricultural Products, by Henry C. Taylor and Anne Dewees Taylor. New York: The Macmillan Company. 1943. xviii, 286 pp. $3.50.

In this volume Professor and Mrs. Taylor have provided background material needed for an understanding of some of the factors underlying the basis for the establishment of a "peace that will endure for many generations to come." This book is an outgrowth of a plan conceived by Professor Taylor, when he was the United States member of the Permanent Committee of the International Institute of Agriculture in Rome, for preparing a general review of the role agriculture played in world trade. The Institute had by 1934 accumulated sufficient statistical and other factual data to provide a picture of world trade and policies.

The authors were fortunate in being able to secure the services of Dr. Lois B. Bacon and Dr. Frederich C. Schloemer whose intensive research contributed to the completion of the 1,100 page volume *World Trade in Agricultural Products: Its Growth; Its Crisis; and the New Trade Policies*, published by the International Institute of Agriculture in Rome in May 1940. A summary of this volume was prepared by Dr. Schloemer at the International Institute of Agriculture at Rome, and published by the Institute in German in May 1941. Of this 96-page summary only a few copies reached the United States. However, this summary and the larger book were treated by Dr. and Mrs. Taylor as the basis for the present study "without the use of quotation marks or direct references."

This timely book provides a concise yet comprehensive survey of the facts and figures concerning world trade in agricultural commodities. It also discusses the national policies, the imperial preferences and the international agreements that have influenced the extent, the character and the direction of this trade. The authors call attention to a world agricultural situation which will present problems taxing the best efforts of statesmen, economists, farmers and business men to find adequate solutions.

The material is well arranged and clearly presented. Each major commodity is treated in a separate chapter which is accompanied by charts, maps, and good statistical tables which supply data on world imports and exports by countries. The commodities so treated are: cotton, wool, silk, rubber, tobacco, coffee, tea, sugar, wheat, rice, feed grains, meat and live animals, fats and oils. The survey of each commodity extends down to the outbreak of the present war. Economists, statisticians, geographers, business men,

government officials, and others interested in agricultural commodities important in world trade should find this a readable useful volume.

JOSEPH S. GOULD

University of Delaware

Treatment of Experimental Data, by Archie G. Worthing and Joseph Geffner. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. 1943. ix, 342 pp. $4.50.

The reviewer is in the awkward position of having agreed to write the review and then realizing after the book was received that he himself had just written one on the same subject, published by the same publisher, and is therefore in position to appreciate a few kind words. One must admire the enthusiasm of the authors for their subject. Their delight in writing about it glistens through the lines. However, one might insist that something more than "a long series of irritations" (preface) should impel an author to do such a dastardly thing as to write a book. Although there are many good points of science in it, and while many of the methods expounded are correct and useful, the book is a disappointment to anyone looking for either something new in methods or a compilation of old ones. It is an example of what can happen when a good scientist without statistical training attempts to write in statistics; the results can be expected to approximate what a statistician without engineering training would produce in the field of engineering. Many of the devices expounded are crude, even when simpler and more elegant ones could have been copied from existing literature. Unfortunately, many statements are even incorrect. There is a paucity of advice to the reader, and some of that little is bad. A large part of the book seems to be a museum with little bearing on the title. The subject of least squares is stated in as many ways as there are types of problems, whereas in reality it can be stated once for all and the procedure unified.

A few examples will illustrate the foregoing remarks. As for incorrect statements, an unfortunate propagation of error occurs on page 263 where it is stated that "It is sometimes possible to obtain more than one least squares value for a given constant by using the same basic relation differently." The same thing occurs on page 247 where it is stated that "The three methods [three ways of writing the equation] will normally yield different best values. . . ." Apparently the authors missed seeing papers by R. Meldrum Stewart in 1920 (*Phil. Mag.*, vol. 40) and Horace S. Uhler in 1923 (*J. Optical Soc.*, vol. 7), and even forgot their own advice on page 249 where they say (correctly) that by taking account of the change in weight upon taking logarithms or otherwise altering the form of the relation, only one set of values will be obtained. There is a perfectly straightforward procedure, yielding unique results, regardless of the form used for the relation to be fitted, and it is a pity that it was not included. The authors also forgot their own advice on page 248 when calculating the weights of the logarithms; what they calculate is the weights before taking logarithms.

There is no mention of the adjustment of observations in curve fitting; which probably accounts for the absence of connection between curve fitting and other problems to which least squares is applied.

Closely related to this apparent lack of appreciation of the principle of least squares is the curious contrivance for fitting a line when both coordinates are subject to error (page 259). The result derived is valid when the x coordinates have the same weight throughout, and the y coordinates likewise, which is the only case they consider. Incidentally, it was published by Kummell in 1876, Karl Pearson in 1901, and Gini in 1921. The more general problem wherein the coordinates have any weights whatever, and the fitted relation is of any form linear or otherwise, is also simple enough as it turns out, and has in fact been published. One must admire the authors for recognizing the importance of this problem (too often neglected), but not their solution nor conclusion that there is no way out in more complicated situations. In this connection it may be of interest to point out that Gauss recognized that the least squares criterion for adjustment must sometimes be applied to the weighted sums of squares of unlike quantities, such as x and y coordinates: "Hoc pacto ne necessarium quidem est, ut functiones V, V', V'', etc., ad quantitates homogeneas referantur, sed heterogeneas quoque (e.g., minuta secunda arcuum et temporis) repraesentare poterunt, si modo rationem errorum, qui in singulis aeque facile committi potuerunt, aestimare licet." (Gauss, *Theoria Motus Corporum Coelestium*, Hamburg 1809).

In spite of the authors' expressed fondness for determinants, the Gauss reciprocal matrix is not used for expressing or deriving the weights of adjusted constants for a fitted curve. Instead, derivations are made afresh for specific purposes (pages 229 and 249). As for uncritical advice one may turn for example to page 171, where Chauvenet's criterion is outlined. It is something of a shock to see that "a criterion of rejection is necessary." I had thought that this idea had been decently buried long ago, along with other statistical criteria for the rejection of observations. As for irrelevant material, there are two chapters on the normal curve, which is finally dismissed as one of those things that one never encounters anyhow. Why not merely describe it as a useful mathematical device? The question is not what shape of distribution one has, but whether one has *any distribution at all*. One has no distribution of any kind unless his data show *stability*, a practical criterion for which is contained in the Shewhart control chart methods. No word regarding stability is given in the book.

The usual $n-1$ is replaced by n (page 167) when a single unknown is involved, but $n-2$ is used on page 250 and $n-m$ on page 261. One excuse given on page 167 for using n is convenience, which is acceptable; but another excuse is that the normal curve seldom exists, which is irrelevant. The authors state on page 238 that the method of least squares gives "a best equation of specified type." Again, on page 239, "Granted the type of equation to be used and the weighting of the data, there is no prospect for the obtaining of a more satisfactory equation than that which the least squares

method yields." Just what is meant by best or satisfactory? Perhaps the answer is supposed to be on page 216 where one reads "The treatment of adjustments here given assumes that the measurements obey the normal distribution law. It further assumes that the most probable values for the k unknown adjusted means are those which yield a maximum probability of occurrence for the weighted measured means." Fortunately there are better reasons for using least squares.

In the treatment of interpolation there is no mention of the remainder term and the possible dangers of ignoring it. No reference is made to Aitken's simple iterative procedure for interpolating and extrapolating, and consisting of operations somewhat similar to the criss-cross evaluation of a determinant, which would doubtless appeal to the authors. The Aitken scheme is particularly adapted to the requirements of the casual user of interpolation. The zig-zag rule is not given, yet it forms the basis of all polynomial interpolation, and is as easy to write down and remember for divided differences as for natural differences. The Lagrange formula given on page 21 is correct but awkwardly written.

Reference is made on page 261 to Gauss' criterion for the goodness of fit of a curve. It would be well to point out that this criterion is equivalent to the calculation of chi-square, and this calculation might well be tied up with the treatment of chi-square on pages 182–5. The treatment of graphical integration and differentiation can not be recommended. Simpson's and Weddle's rules are a part of the discipline of mathematicians, but little comfort to the physicist or engineer because of the subtle differential weighting given to the ordinates, and the requirement of uniform spacing. It seems much better to approach the problems of graphical integration through the Euler-Maclaurin sum. It is uncritically stated on page 92 that "graphical methods . . . permit the calculation of derivatives . . . from the original data." Must one not know something about the wiggles that the curve takes between the tabulated points? Again, one must not neglect consideration of the remainder term.

The treatment of Fourier Series propagates an abomination known as Fourier's "half-range" sine and cosine series, which from a pedagogical standpoint is most confusing. The series covers the full period, and to mention a half-range series to the beginner is like telling the children not to put beans up their noses.

The greatest fault is lack of purpose. Why does one wish to fit a curve in the first place? What is he going to do with it when he gets through? Why does one adjust the angles of a triangle? What is the purpose of adjustment? Why does one take data? Why does one wish to present data? As a guide in framing a course of action, of course, or for predicting the result of a future experiment, but one can search the book in vain for the answer.

Several good points deserve mention. On page 58 the authors give a little known device for straightening a curve and thus discovering whether some particular form seems to fit. On page 198 the discussion of constant errors

is excellent. Section 11 on page 200 continues the discussion and is likewise excellent. Numerous interesting problems are given at the ends of the chapters. The summary of each chapter is helpful.

In conclusion the reviewer expresses the hope that Messrs. Worthing and Geffner may have the pleasure of writing a review of his book.

W. EDWARDS DEMING

Bureau of the Census and
Bureau of the Budget

Sampling Methods in Forestry and Range Management, by F. X. Schumacher, and R. A. Chapman. Durham: School of Forestry, Duke University. Bulletin 7. 1942. 213 pp. $2.00.

This book presents a treatment of statistical methods applicable not only to the sampling needs of foresters and range managers, but also to a wide variety of field investigations common to many branches of science and more particularly to biological investigations. The present title may very well tend to keep it out of the hands of many readers who would find it a textbook for which they have been seeking.

The authors have devoted the major part of their energies for the past 15 years to developing objective methods of evaluation of experimental results and fostering the use of better methods of experimentation in this complex field of work. They are among the leaders in this line of endeavor. The present book is the culmination of their joint efforts.

Of special interest to foresters, it should be pointed out that much of the example material is drawn from two fields of work, estimating of timber volume and sampling in forest tree nurseries, concerning which the authors are especially well prepared to write.

The book is divided into three parts: statistical background, direct estimates by sampling, and indirect estimates through regression, and concludes with a discussion of "certain practical aspects of sampling." The development progresses from the simple case of sampling a single variate in a small rectangular area to the sampling of a multivariate population in which increased precision is sought by means of regression and recognition of stratification.

In their treatment of the subjects, the authors have avoided consistently the authoritative type of statement met so frequently in the average elementary textbook on statistical methods. Whenever a principle or formula is used, it is developed algebraically in the text. So thoroughly is this done and for so wide a coverage of the subject, that the book provides a very useful exposition of the algebra of the analysis of variance and covariance. It strikes the reviewer as slightly incongruous, however, to find commonly used terms carefully defined and then encounter a phrase such as "mean square due to regression" defined only by a demonstration of its use.

The authors state in the preface, "Such use as is made of mathematics

in the following pages presupposes no special training in the subject beyond the modest requirements of a forestry curriculum." The reviewer feels, however, that the authors have taken something for granted because, while the modest mathematical requirements of a forestry curriculum may serve as an adequate basis upon which to build, the average forester or range manager would find it necessary to devote considerable time and study to develop his knowledge of mathematics to the point where he could use the procedures outlined with facility. Moreover, their brief discussion of fundamentals would not enable the average worker readily to understand the more complex discussions unless he is already possessed of a reasonable knowledge of statistics. The book, therefore, requires a certain knowledge of statistics to begin with.

The work shows throughout the authors' study of and close adherence to the school of statistical thought led by Professor R. A. Fisher, even to the symbols used.

The treatise implies the use of the random sampling method in estimating timber volume on forest tracts of considerable size and of a regular outline—a problem usually confronted by the "timber cruiser" or "range surveyor." Although random sampling as outlined will no doubt afford a valid estimate of sampling error in timber cruising, it will give no greater accuracy in the estimate of volume than systematic sampling. Then, too, random sampling involves certain mechanical difficulties in pursuing the work on the ground. In the illustration used in the book (figure 18), the random selection of some sampling units (strips), in some cases as little as 200 feet apart in a block having a width of 1600 feet, and as great as 1000 feet apart in other blocks, and leaving unsampled areas as wide as 2000 feet in adjacent blocks, would create doubts in the minds of "practical" cruisers as to the accuracy of the data, at least for the individual blocks. This suggests the need for further attention to the development of methods for determining the valid estimate of sampling error using systematic sampling methods. The results of a preliminary investigation in the use of the systematic sampling method were published subsequent to the time Schumacher and Chapman's treatise went to press (Osborne, James G., "Sampling Errors of Systematic and Random Surveys of Cover-Type Areas," this JOURNAL, June 1942, Vol. 37, pp. 256–264).

The work, however, will find very great usefulness in field experimentation in forest and range investigations and related lines of work. The authors have rendered a real service in assembling in one place the essentials of so much of the widely scattered information and literature on sampling and organizing it into a useful treatment. Altogether, the strong points of this publication far outweigh its weaknesses and the breadth of the application of the principles demonstrated is sufficient that the book is a "must" for workers in forest, range and related fields of experimentation.

C. L. FORSLING

U. S. Forest Service

Business Mathematics, by Cleon C. Richtmeyer and Judson W. Foust. New York: McGraw-Hill Book Company, Inc. Second Edition. 1943. xv, 401 pp. $2.75.

Persons with negligible training in mathematics who want to acquire sufficient foundation for practical work or further study in the business uses of mathematics will find this a very useful book. The scope of the book is fairly extensive. Numerous exercises, problems, and self-tests are scattered throughout the book, and in the back are the usual mathematical tables.

A good set of definitions and rules concerning approximate numbers, significant digits, and accuracy and precision in approximate computations is given early in the text. The solution of simultaneous equations is covered, and the derivation of the normal equations required for a problem involving two unknowns by the method of least squares is explained without the aid of calculus. The treatment of annuities is preceded by and grows logically out of a chapter on geometric progressions and compound interest. It includes a treatment of sinking funds, depreciation, amortization, and bonds. How to ascertain the yield of a bond, however, is excluded, as is any consideration of life annuities or insurance.

The chapter on statistics deals only with ungrouped data. Measures of central tendency, measures of variability, standard measures or z-scores, simple correlation, straight line trends, and index numbers are explained and illustrated. The reviewer believes it would have been better if the authors had always put the frequencies in the right-hand column of a frequency table, if they had not adopted such a difficult explanation of correlation, and if they had not ignored the basic idea that index numbers are essentially composites obtained by combining related variables. Also in a book of such a generally elementary character it seems a little unbalanced to develop and extensively apply the technique of least squares, but completely neglect any consideration of frequency distributions or of index numbers.

Perhaps the chief criticism of the book is that the authors appear to be as much interested in mathematics and in the problems of the educational world as they are in the problems of business.

DUDLEY J. COWDEN

University of North Carolina

Consumer and Opinion Research, The Questionnaire Technique, by Albert B. Blankenship. New York: Harper & Brothers. 1943. x, 238 pp. $3.00.

When a new era of social research is opened up the matter usually comes to the attention of the scientific fraternity in three steps. First, concrete studies are reported highlighting specific technical aspects. Then these experiences are combined into "How To Do It" type of books. Finally as the field grows and good methodological thinking is done, it becomes possible to derive the techniques from a few basic principles. The present volume belongs to the second level and shows that the author kept his mind open for whatever could be done on the third level. Blankenship has seen that two fields which

are usually treated separately, to wit; market research and public opinion research, are really the same unit.

In the introduction he gives some useful historical hints and then boils down the rules of the game to thirteen sections. Some of the sections are well established units like sections 5, 6 and 7 on questionnaires, Sections 8 and 9 on sampling, and section 11 on interviewing. In the field of wording of questionnaires, Blankenship did much original research in previous years and it is valuable to have his as well as other material assembled in one book. The chapters on sampling are necessarily sketchy. Perhaps it would have been better if the author had not reproduced again the well known tables on sample size used in random sampling. After all the real problem is that the actual sampling we deal with is much more complex than the present text would lead the reader to expect.

In certain other sections Blankenship has made the first attempt to summarize the current procedures into a set of rules. In Section 3 for instance he tries explicitly to clarify how an administrative problem is translated into terms of research. In Sections 12 and 13 he attempts to make the writing of the report a more systematic process and thus contributes to the "codification" of this new field.

At this point this reviewer might be permitted to give one example as to how the progress from empirical rules to a coherent system can be made. In his section on "Requirements for Classification," Blankenship refers mainly to a set of rules published ten years ago by this reviewer. By now thinking on this problem has progressed to a more advanced level. If we have a few hundred answers to an "openended" question, our classification has to proceed by steps. The first set of categories has to take into account the different ways the question was interpreted by the respondents. Then only can we proceed to classifications relative to the actual content of the replies. All rules or classifications in opinion research can be derived from this basic fact: complex questions always leave room for different interpretations by the respondent. Therefore, we have to classify answers first as to what the respondents thought they were asked. Then subcategories are needed to classify what the respondent meant to answer to the question as he understood it.

Blankenship's effort to gather what research people are actually doing into a coherent set of rules will prove helpful to a great number of people who either want to get acquainted with this new field or are looking for some frame of reference to orient them in the turmoil of their own daily work. Instructors will find in Blankenship's book a welcome supplement, e.g., to Lundberg's *Social Research*, especially with students training themselves for business or government jobs.

Paul F. Lazarsfeld

Columbia University

The Chicago Mental Growth Battery, by Frank N. Freeman and M. A. Wenger. Chicago: The University of Chicago Press. 1943. v, 58 pp. $1.00.

This is a battery of ten group tests for the study of intellectual develop-

ment graded in difficulty for use from the third grade through the twelfth. It includes six verbal and four non-verbal tests, chosen to meet these requirements; namely, that they (a) be generally recognized as suitable for measurement of intellectual behavior, (b) have high positive correlation with the general factor in the bi-factor analysis of the preliminary data, (c) be applicable over a wide age range but demand presumably the same or similar mental processes, (d) be adaptable to multiple-response scoring, (e) have intrinsic interest to the testee, and (f) permit group presentation without imposition of time limits.

The non-language tests are as follows:

1. *Picture sequence.* A disarranged series of cartoons of Uncle Elby and his dog Napoleon.
2. *Pattern analogies.* Most of the items have been taken from the Thurstone material in the American Council on Education Psychological Examinations, with a new set of instructions adapting the items to use in lower grades.
3. *Paper Form Board.*
4. *Series Correction.* A modification of the Army X-O series.

The language tests are as follows:

5. *Problems.* This is adapted from Burt's Test of Reasoning, with the addition of some syllogistic reasoning and items similar to those in the *Army Alpha.*
6. *Vocabulary.* Adapted from the Vocabulary Test in the I.E.R. CAVD scale.
7. *Verbal Analogies.* These items were selected from those standardized by Pintner and Renshaw.
8. *Word Grouping.*
9. *Sentence Completion.* Adapted from the I.E.R. CAVD scale.
10. *Opposites.*

The tests are arranged to permit machine scoring but the authors feel that little saving would be effected thereby unless very large groups are to be examined. A separate answer sheet is not provided nor recommended. The tests are legible and attractive in appearance. They are power and not speed tests. While there is no time limit most subjects can complete them in five sittings of one hour each.

Correlations of the separate tests with the general factor in a bi-factor analysis are fairly high, 22 out of 31 coefficients reported being between .60 and .85 and only three being below .50. The tests were standardized on thirteen different groups totalling 2707 persons, none of whom took all the tests, and a procedure of weighting and equating was devised to secure comparable scales for the ten tests. Each item retained in the final test was scaled by computing the percentage of persons failing the item, and by reading the corresponding value of x/σ from a table of the normal curve. In this way an item would receive a different scale value for each group to which it was

presented. All such scale values for a given item were averaged after each had been transformed by adding to it the amount by which the mean scale value of the Basic Group (grades 3 to 6) exceeded the mean scale value of the group in question.

The authors have set an admirable precedent of presenting the basic data on which each item was scaled and it is a great pity that so few test makers follow this excellent practice. Commercial publication of the battery of tests is not contemplated but a sample may be obtained through the University of Chicago Press at a cost of one dollar and the entire battery or parts of it may be used by permission of the authors.

Helen M. Walker

Teachers College, Columbia University

The Adolescent Criminal, by W. Norwood East. London: J. & A. Churchill, Ltd. 1942. xi, 327 pp. 45 shillings.

This is a report of the findings of a study of 4000 male adolescent offenders, aged 16 to 21 years, received at the Boys' prison from London and its surrounding districts during the years 1930 to 1937. The purposes of the inquiry were, "first, to obtain the fullest information which would enable ample consideration to be given to each case before recommending the lad to the Court of Trial as a suitable subject, on general grounds, for detention in a Borstal institution; second, to ascertain the presence of any mental defectiveness or other mental abnormality which should be reported to the court; third, to utilize the medical data and other factors in the life histories of the lads to assist in the classification of the various types of offenders and to ensure their transfer to the appropriate Borstal institution. . . . The fourth object of the investigation . . . was to apply modern scientific methods to the elucidation of some of the causal factors which contribute to adolescent criminality."

We are assured by the authors that the 4000 offenders studied were unselected except for age, the region in which they lived, and the period of time covered by the investigation. Within these limits they comprise a consecutive series of cases received at the Boys' prison from the courts. The series was limited to offenders from London and its adjacent communities so that their homes could be visited and their relations could be interviewed.

The facts pertaining to each case were secured from personal interviews with the offenders after their reception into Boys' prison, from home visits, medical examinations, psychological tests, questionnaires filled out by school masters, employers, probation and police officers. From all these sources efforts were made to secure facts relative to seven major categories of factors, namely, hereditary and familial factors; home environment; school progress; employment record; physical growth, physical defects, and record of physical disease; intelligence rating, mental defectiveness, and mental disease; and personality traits. After the facts under each of these categories were secured, they were tabulated and their statistical frequency determined for such subgroupings as age, types of offenses, and number of previous convictions.

The authors conclude from their analysis of their data that criminal heredity; certain forms of mental disorders such as schizophrenia, manic depressive psychosis, hysteria, compulsive obsessive neurosis; paranoid types of personality; absence of one or both parents from the home; and unemployment were factors which seem to have causal significance. Except for offenders charged with sex delinquency, there was a significant correlation between multiple convictions and residence in a poor class district. The cases of sex offenders showed no such correlation.

This study represents an extensive and conscientious attempt to discover the physical, mental, and social factors associated with adolescent criminality. It contains a wealth of statistical material which should be of great value to students of the problem. It should be stated, however, that since the incidence of the variables considered is not known with respect to the general population, or the non-criminal population, there is great difficulty in establishing their significance as causal factors in the lives of delinquents.

CLIFFORD R. SHAW

Institute for Juvenile Research

War Labor Supply Problems of Philadelphia and Its Environs, by Gladys L. Palmer, assisted by Samuel M. Cohn. Philadelphia: University of Pennsylvania, Industrial Research Department of Wharton School of Finance and Commerce. Research Report No. 5. 1942. vii, 54 pp. 50 cents.

This fifth report in the series issued by the Industrial Research Department of the Wharton School seeks to describe major changes in the Philadelphia labor market during 1940 and 1941, changes resulting from the defense and war production programs. The study covers the period from June 1940 to April 1942, although much of the statistical material is restricted to the months before January 1942. It was undertaken to discover what major problems must be faced in mobilizing the manpower of this particular area for war.

The authors first considered shifts in employment necessitated by changing demands for labor. They then appraised the major difficulties involved in making these manpower conversions, including reasons for labor immobility, frictions in local wage structures, and limitations in housing facilities.

Attention was next directed to means by which expected demands for labor could be met. Note was made of the obviously increased use of public employment exchanges as a means of facilitating and directing transfers, as contrasted with a declining dependence on "help-wanted" advertising. One important means of facilitating transfers, they conclude, would involve the relaxation of hiring specifications and discrimination against Negroes, women, and both younger and older workers. Means of increasing labor supplies by calling on potential reserves and improving the efficiency of manpower utilization are also considered, and attention is directed to the possibility and desirability of in-migration to augment local labor supplies.

An entire chapter is devoted to a comparison of labor supply situations in this war with that in World War I. The authors conclude that labor is much more mobile now, principally because of improved commutation facilities. They find that shortages of unskilled labor have been definitely less serious in early stages of this war, and that there has been less demand for additional women workers. Finally, they note the wider use of public employment services in 1941–42 as compared with 1917–18.

A final brief section describes five "immediate" labor supply problems in the Philadelphia area, including those arising out of limitations on transportation facilities; traditional hiring and union membership restrictive practices; inadequate training facilities and programs; neglected opportunities for the employment of women, older workers and the physically handicapped; and the limited provision of facilities for effecting transfers from less essential to more essential work.

The study is already an interesting historic document on the early phases of manpower mobilization. Many of its conclusions might now be questioned, as, for instance, those holding that the present war shows a lessened demand for unskilled workers, for women, or for minority groups or handicapped workers, or that there is less labor turnover in the present conflict. The study reflects the continued inadequacy of even the most important labor market statistics. At several points, as, for instance, in discussing "in-migration," the authors simply state that realistic data were not available.

There is some evidence of the pressure of war in the preparation of this study. Several of the charts are confusing and poorly designed. There are careless statements, such as that (on page 5) which declares that when industrial production reached an all-time high in 1941, it surpassed the previous high in 1929. But, on the whole, the study is a valuable bit of documentary evidence describing early impacts of war on a local labor market.

Dale Yoder

Regional War Labor Board, Chicago

Financing Small Corporations in Five Manufacturing Industries, 1926–36, by Charles L. Merwin. New York: National Bureau of Economic Research. 1942. xvi, 172 pp. $1.50.

Under its Financial Research Program, the National Bureau is sponsoring a series of studies in Business Financing designed "to trace from business accounting records the structural and cyclical changes that have occurred in the financial organization of business enterprise since the turn of the present century." Dr. Merwin's monograph constitutes the initial volume in this series.

The study is based on a sample of about 1200 small corporations (defined as those with assets of less than $250,000) in five industries—baking, men's clothing, furniture, stone and clay products, and machine tools—characterized by small enterprises and representative of diverse types of production (producers' goods, and perishable, semi-durable and durable consumers'

goods). Since relatively few small companies publish financial statements, the basic material needed for the study could be found only in federal income tax returns. The sample companies were selected from the income tax files of 1926 and 1930 and the returns of the same companies were then pulled for each successive year until 1936, or, in the event of discontinuance prior to that year, through the last year for which a return was filed. The laborious and costly task of assembling these returns and tabulating data from them had already been performed for a report of the Department of Commerce to the Temporary National Economic Committee (published as Monograph 15) on *Financial Characteristics of American Manufacturing Corporations*, of which Dr. Merwin is also the author. The present volume is based on a more detailed analysis of this unique compilation of financial data than time permitted him to make for the T.N.E.C. report.

The monograph deals mainly with three aspects of the financial experience of small companies: their profitability, the sources of their funds, and trends in their credit ratios as portents of discontinuance. The principal conclusions reached on these matters are briefly as follows:

(1) The return on the capital invested in small corporations is generally meagre. But their profitability, unlike that of large companies, cannot be measured simply by this standard. The owners of small corporations are as a rule also the managing officers, and part or all of their compensation must be included in net income if the earning power of small corporations is to be realistically appraised.

(2) Small companies incur very little long term debt but depend for their financing chiefly on equity capital from inside sources and on short term borrowing (accounts and notes payable).

(3) The approaching collapse of small companies is reflected in their financial structure for a number of years before their formal discontinuance. Growing weakness in the companies which failed during the period surveyed (over half of those included in the sample) was generally revealed by downturns in the ratios of net working capital to total assets, current assets to current liabilities, and net worth to total debt.

There is, of course, nothing novel in these conclusions. They are familiar and accepted generalizations. But by providing a much firmer statistical support for them than has hitherto been available, the author has done a very useful piece of work. He has handled his basic data carefully and taken pains to point out their limitations.

In view of the relatively narrow scope of the study, he has not attempted to prognosticate from it the future of small business in the United States. He does, however, conclude that long-term credits are ill-adapted to the needs of small corporations and that they must continue to depend for their financing mainly on inside equity capital and short-term credits.

WILLIAM H. WYNNE

Office of Civilian Requirements
War Production Board

Taxing to Prevent Inflation, by Carl Shoup, Milton Friedman and Ruth P. Mack. New York: Columbia University Press. 1943. xii, 236 pp. $2.75.

The four essays in this brief volume represent the results of an inquiry into various techniques, which may be serviceable in devising quantitative measurements of the inflationary gap, and the revenue requirement necessary to close it. The authors are concerned in this study "exclusively with the kind of inflation that threatens to arise from the discrepancy between consumer incomes and the volume of goods and services available."

Various short-cut methods, which have been used to indicate the inflationary gap, are criticized as inadequate and even dangerous, since they are apparently too simple in their approach. But it is questionable whether much of practical usefulness is gained by evolving a detailed technique of measuring the inflationary gap. Deficiencies in factual data alone limit the applicability of the suggested techniques to making any final estimates of tax needs.

Part I presents an analysis of the many dependent as well as independent variables, such as assumed changes in total output, consumer spending, diversion of resources, net capital formation, instalment buying, voluntary saving, speculation, export balance, and similar items, all of which have a bearing on the size of the inflationary gap. Piecemeal quantitative estimates are made of these inter-related factors, and alternative sets of assumptions concerning increases in total output, defense spending, and diversions are tabulated.

Part III begins with a categorical statement that inflation has its genesis in an increased volume of spending by consumers, business, and government. But neither here nor elsewhere in the study is adequate consideration given to the possible effects of alternative sources of increased consumer spending power which bears so directly on the creation of the inflationary gap. The quantitative measurements of the various items considered and their interrelationships are apt to vary considerably, depending on whether additional spending power during the various stages in the conversion of the economy to a total war footing takes the form of fiat money or of expansion of bank credit.

While much of the detailed analysis of techniques for measuring inflation is rather involved—and at times difficult to follow partly because of the complex array of alternative possibilities presented and the many variables considered—the discussion of taxes available to avert inflation is distinctly clarifying and illuminating. The advantages and disadvantages of a retail sales tax over a personal net income tax, with stoppage at the source, are ably explored. The merits of a retail sales tax designed to reduce consumer spending power generated by war production are clearly recognized. But it is emphasized that any endorsement of such retail sales tax as a war measure, seeking to hold down price inflation, implies no preference for a sales tax as a normal part of a peacetime fiscal program.

Part IV, which deals with the effects of price changes upon production,

spending, and saving from one period to another, is dotted with a certain amount of figurative language, which lends a salutary literary flavor to an otherwise highly technical discussion. The following excerpts are typical:

"The forecaster must learn the weight of the mooring and the length of the mooring chain and must attempt to predict the movement of the wind and current in order that he may surmise how the floated markers will shift."

"A brief enumeration of them [evaluations and judgments] will provide a scaffolding sufficient to support the skilled climber likely to venture into the rarified atmosphere of these pages."

Having ploughed through the pages of the volume meticulously, one can agree with the author of Part IV that "as the margins narrow the mud becomes less sticky, the road hardens and the spirit of enterprise can ride again."

KARL SCHOLZ

University of Pennsylvania

Belgian Banking and Banking Theory, by B. S. Chlepner. Washington: The Brookings Institution. 1943. x, 224 pp. $2.50.

Professor Chlepner is a foremost authority on Belgian banking, and it is to the credit of the Brookings Institution to have made available in English, if only in a short compass, the results of his research. The first three chapters of this very readable little book offer a concise history of banking in Belgium, enlivened by international comparisons. The following three chapters deal with governmental policy, especially with the banking reform since 1934, and with public credit institutions. Four chapters of a theoretical nature, with applications to Belgian banking history, conclude the text, supplemented by a short bibliography.

Professor Chlepner analyzes banking legislation after the great crisis in realistic terms: how it actually operated, and how little it meant in changing the practice of banking, contrary to legislative intentions. These chapters (on policy) are, in the reviewer's opinion, the most worth-while contribution of the book. Its historical section is the best available presentation of the subject, but it is far from being fully satisfactory. One might have wished, e.g., to learn some details of a factual nature about the intimate inter-connection of finance and industry in Belgium. The role of Belgian banks in the international money markets—at times a very important one—is almost entirely ignored. The unsatisfactory treatment of such significant aspects of Belgian banking may have to do with the fact that their discussion cannot be based on statistics and other publications, while the author's approach to banking history is on the whole that of the academic observer who had little direct acquaintance with the actual functioning of the credit machinery. He offers little insight into it other than by inference from statistical and similar material.

This lack of an "inside" understanding of the banking procedure expresses

itself in the liquidity-theories of the author. Dr. Chlepner emphasizes that Belgian banks operated on a meager cash liquidity ratio and with a disproportionately small volume of self-liquidating "discounts" as compared to industrial loans, and draws hasty conclusions along lines identical to H. G. Moulton's well-known approach. He overlooks, however, that Belgian banks could permit themselves low cash ratios because they could rely on British, French and Dutch institutions and on capitalistic groups with substantial gold holdings, a fact that did not appear in the statistics. He also overlooks the fact that the liquidity of an earning asset is not determined by the technical form in which it is dressed. In Belgium, as elsewhere, "loans" were different from "discounts" often only in the legal form. Again, the meager statistical data give no clue. They have actually misled the author into false generalizations, which in turn obscure his outlook on business cycles and on the role "mixed" banks of the Continental type play in the cyclical upheavals.

Melchior Palyi

Chicago, Illinois

PUBLICATIONS RECEIVED*

Benedict, Ruth, and *Gene Weltfish*. *The Races of Mankind*. New York: Public Affairs Committee, Inc. 1943. 31 pp. 10 cents.

Brown, Benjamin H. *The Tariff Reform Movement in Great Britain, 1881–1895*. New York: Columbia University Press. 1943. x, 170 pp. $2.50.

Chase, Stuart. *Where's the Money Coming From?: Problems of Postwar Finance*. New York: The Twentieth Century Fund. 1943. ix, 179 pp. $1.00.

Ford, Robert S. and Marvin A. Bacon. *Michigan Highway Finance*. Ann Arbor: University of Michigan Press, Michigan Governmental Studies No. 12. 1943. viii, 191 pp. 75 cents.

Hall, Ray Ovid. *Handbook of Tabular Presentation*. New York: The Ronald Press Company. 1943. viii, 112 pp. $3.50.

Hamburger, L. *How Nazi Germany Has Controlled Business*. Washington: The Brookings Institution. 1943. 101 pp. $1.00.

Kulischer, Eugene M. *The Displacement of Population in Europe*. Montreal: International Labour Office. 1943. iv, 171 pp. $1.50.

League of Nations. *Agricultural Production in Continental Europe during the 1914–18 War and the Reconstruction Period*. New York: Columbia University Press. 1943. 122 pp. $1.75.

Lorwin, Lewis L. *Postwar Plans of the United Nations*. New York: The Twentieth Century Fund. 1943. xii, 307 pp. $2.50.

May, George O. *Financial Accounting, A Distillation of Experience*. New York: The Macmillan Company. 1943. ix, 274 pp. $3.00.

Neiswanger, William A. *Elementary Statistical Methods*. New York: The Macmillan Company. xviii, 740 pp. $4.00.

Nicholls, W. H., and John A. Vieg. *Wartime Government in Operation*. Philadelphia: The Blakiston Company. 1943. xiii, 109 pp. $1.50.

Papier, Rose L. *Unemployment Compensation Experience of Beneficiaries in Columbus, Ohio: 1939–1940*. Columbus: The Ohio State University, The Bureau of Business Research. 1943. xiii, 82 pp. $1.50.

Riegel, John W. *Paving the Way for an Incentive Plan*. Pasadena: California Institute of Technology. 1943. 18 pp.

Slichter, Sumner H. *Present Savings and Postwar Markets*. New York: McGraw-Hill Book Company, Inc. 1943. iv, 73 pp. $1.00.

Spahr, Walter E. *Allied Military Currency, Some Queries and Observations*. New York: Economists' National Committee on Monetary Policy. 1943. 30 pp.

Stettinius, E. R., Jr. *Lend-Lease Weapon for Victory*. New York: The Macmillan Company. 1943. xiv, 358 pp. $3.00.

Whittlesey, Charles R. *The Effect of War on Currency and Deposits*. New York: National Bureau of Economic Research, *Our Economy in War*, Occasional Paper 11. 1943. 50 pp. 35 cents.

Government Publications

International Labour Office. *The Health of Children in Occupied Europe*. Montreal: International Labour Office. 1943. 37 pp. 25 cents.

Thompson, Warren S., and P. K. Whelpton. *Estimates of Future Population of the United States, 1940–2000*. Washington: Superintendent of Documents, U. S. Government Printing Office, National Resources Planning Board. 1943. 137 pp. 35 cents.

* Annual reports and publications presenting statistics collected at regular intervals have been omitted from this list. Some items of minor interest to statisticians have also been omitted. The contents of periodical publications are not listed, but the attention of the reader is directed to the lists of articles in current publications which are to be found in the *Revue de l'Institut International de Statistique*, *Journal of the Royal Statistical Society*, *American Economic Review*, *Population Index*, *Transactions of the Actuarial Society of America*, *The Record of the American Institute of Actuaries*, and *Sankhyā The Indian Journal of Statistics*.—Editor.

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THE INTER AMERICAN STATISTICAL INSTITUTE: FOUR YEARS OLD

BY STUART A. RICE

First Vice President IASI, U. S. Bureau of the Budget

PARENTAGE

FOR MORE THAN HALF a century before the present war the world-wide honor society known as the International Statistical Institute upheld with dignity the conception of internationalism in statistical science and practice.[1] While its influence beyond question was real and wholesome, this influence was more passive than dynamic and was confined to areas of the world which already possessed a well-developed statistical tradition. These, in general, were Europe west of Russia and America north of the Rio Grande. Members from other areas were few in number and significant contributions by the Institute to statistical developments within them were almost completely lacking. Among the 215 members in 1939, only 6 were accredited to Latin American countries: 1 to Argentina, 3 to Brazil and 2 to Mexico. Yet it was precisely in the vigorous young nations of Latin America that aggressive stimulation of an awakening statistical interest was most likely to produce rapid statistical progress.

In this setting it is easy to see that formation of the Inter American Statistical Institute in no way reflected an abstract conception of political or economic regionalism. It merely reflected the limitations of its parent organization, the ISI, as a positive instrument for the development of statistical traditions in a major world area where these were lacking and greatly needed.

It is possible that except for the outbreak of World War II, the parent body would have been converted into a vital force for statistical progress in all parts of the world. North American delegates at the 24th biennial session in Prague in September, 1938, suggested the likelihood of regional separatism in the continued absence of genuine internationalism within the International Statistical Institute. Subsequent

[1] Whether the ISI has maintained an organised existence on the continent of Europe during the War is not known here.

proposals by Julin, Institute president, would have permitted an autonomous statistical program for the western hemisphere within the structure of the parent organization. Consideration of his plan was forestalled by world events which compelled their forecast of separatism to be taken seriously by those who made it and actually to be carried out. Nevertheless, the founding members of the Inter American Statistical Institute were and are convinced that worldwide scientific collaboration is desirable in the field of statistics as elsewhere; and the Statutes which they prepared for the new organization leave open the way for an ultimate reaffiliation with its global forebear.

The birth date of the new Institute may conveniently be recorded as May 12, 1940. On that day 12 members of the International Statistical Institute from Argentina, Canada, Mexico and the United States met at the Cosmos Club in Washington during the sessions of the Eighth American Scientific Congress and established a preliminary organization.

The services and resources of the United States Arrangements Committee for the Twenty-Fifth Biennial Session of the International Statistical Institute (indefinitely deferred because of the war) were made available for the tasks of completing the organization.[2] Statutes were drawn and approved, an initial "constituent" membership was established, the required minima of governmental adherences and appropriations were secured and the new Institute's affairs were placed in the hands of its own elected officers at a meeting in Charlottesville, Virginia, on August 21–23, 1942.

ORGANIZATION[3]

The new Institute sought escape from the chief organizational handicap of its parent. The International Statistical Institute is limited to maxima of 25 ordinary and 5 honorary members from any single Nation and to totals of 225 and 25, respectively. These members are elected for life, without regard to continuation of the factors which may have counted heavily in their original selection. The heads of official statistical services were frequently elected to membership because of an official eminence which proved temporary. A portion of the limited number of memberships was thus at any time preempted by an older generation of former office-holders without current claims to professional distinc-

[2] The Committee was originally composed of Halbert L. Dunn, Raymond Pearl, Walter F. Willcox and Stuart A. Rice, Chairman. Following Pearl's untimely death his place was filled by E. Dana Durand. A number of ex officio institutional members have subsequently been added to the Committee to assure responsible disposition of its remaining funds at such time as circumstances may permit their expenditure for the resumption of worldwide statistical relations.

[3] See the organisation chart reproduced with this article.

tion. The Inter American Statistical Institute, on the other hand, provides that the chief statistical officer of each American Nation (including Canada) shall be *ex officio* a member of the Institute *during term of office only*. He may also be elected to "constituent" membership, but only as a person "distinguished for . . . professional attainments and for . . . contributions to statistical science and development in the Western Hemisphere . . . " These *ex officio* members in most cases serve also as *correspondents* of the Institute on behalf of their respective nations.

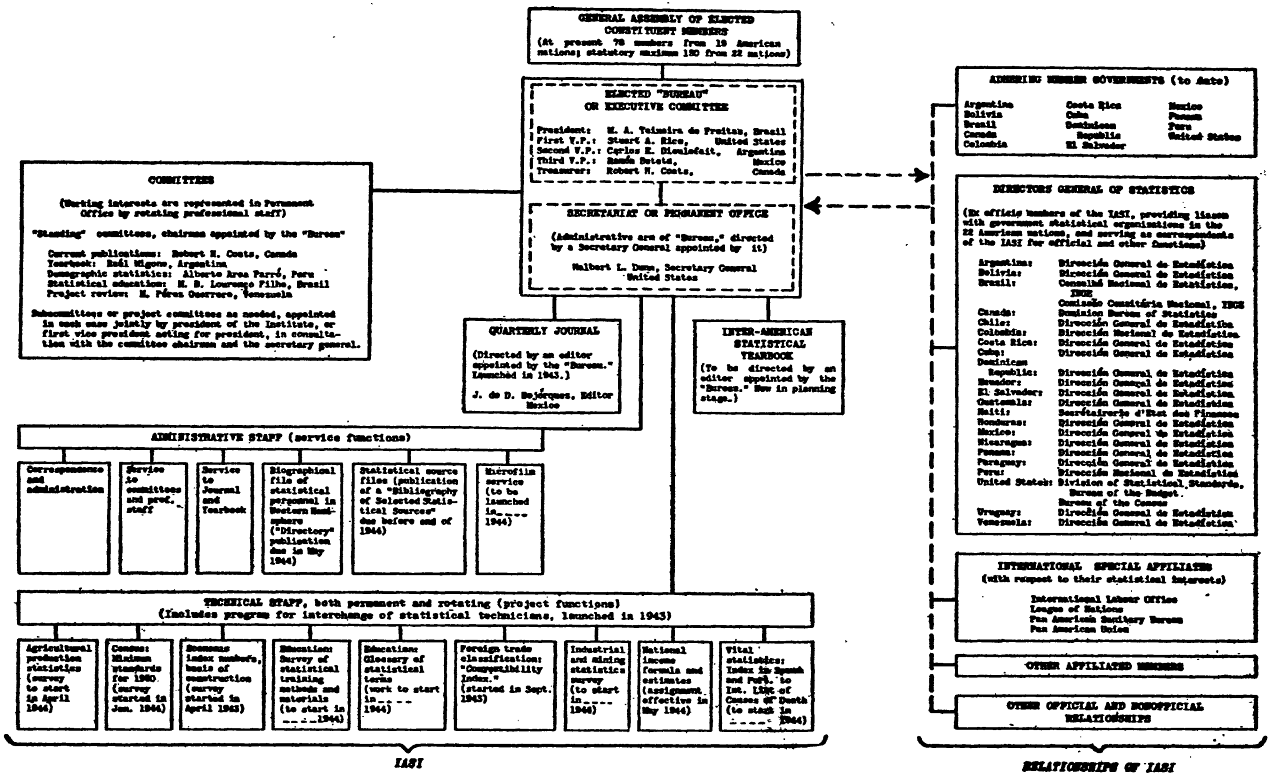
The Institute is unique among international organizations in that control of its affairs is held tightly by its "constituent" or professional members while its principal income is received from governmental sources. "The government of the Institute is vested in the general assembly of constituent members . . ." The dues of governmental members have been fixed at 20 cents per 1,000 of population, as determined for similar purposes by the Pan American Union. Each member government is asked to name an ex officio member to represent it, and the same representation is given to other organizations which may be admitted to "adhering" membership upon their demonstration of statistical interest and the payment of an annual membership fee of $100.

At this writing the following governments in order of adherence have become members of the Institute: Dominican Republic, Bolivia, Mexico, Costa Rica, United States, Brazil, Peru, Panama, Canada, Colombia, Argentina, El Salvador, Cuba and Ecuador. The participation of the Dominion of Canada for the first time in an officially recognized inter-American organization is especially noteworthy. The Brazilian Institute of Geography and Statistics and the General Bureau of Statistics of Uruguay are the present adhering members other than governments, while the Pan American Union, the Pan American Sanitary Bureau, the International Labour Office and the League of Nations have been recognized as special affiliates. The controlling "constituent" membership now numbers 78 persons from 19 American Nations.

The Institute is headed by a President, three Vice Presidents and a Treasurer, each elected by the constituent membership and each accredited to a different member country. Together these officers constitute the "Bureau," or executive committee, which is the governing body "during interims between regular sessions" of the General Assembly. The Permanent Office is located in the Census Building in the City of Washington, under the direction of a Secretary General elected by the Bureau.

Although the Permanent Office maintains a central staff it is a settled policy that, so far as may be practicable, the Institute's activities will

INTER AMERICAN STATISTICAL INSTITUTE (IASI)*
FUNCTIONAL CHART



* For further details, see *The Inter American Statistical Institute—Its Origin, Organization, and Objectives*, Washington, D. C., 1943, 48 p.

be decentralized throughout the hemisphere. This decentralization will be evident in the description of current and pending activities which follows hereafter.

COMMITTEES

At the first session of the Bureau five standing committees were created through which to direct projects undertaken: A Committee on Projects, headed by M. Pérez Guerrero of Venezuela, has functions analogous to those of the Problems and Policies Committee of the Social Science Research Council in the United States. It serves both as a planning and a screening instrument, and the results of its work will generally appear in the creation of *ad hoc* project committees for particular approved undertakings. William F. Ogburn of the United States serves as Technical Adviser to this Committee, the remaining members of which are Institute members from Argentina, Chile and Cuba.

Because of the central importance of its publications in the Institute's plans the Committee on Current Publications (headed by Robert H. Coats of Canada) and the Committee on the Inter-American Statistical Yearbook (headed by Raúl C. Migone of Argentina) have in their respective memberships all members of the Bureau. A Committee on Statistical Education, under the chairmanship of M. B. Lourenço Filho of Brazil, has jurisdiction over project proposals and undertakings designed to improve the methods and materials of statistical training, while a Committee on Demographic Statistics, headed by Alberto Arca Parró of Perú, was given similar responsibility for project proposals dealing with population censuses, vital statistics, and other demographic data. Regardless of the work which might subsequently be undertaken in other directions, it was deemed clear and essential that the Institute should move in the directions indicated by its five standing committees from the very start.

The Projects Committee is establishing a subcommittee on Standards for Balance of International Payments Statements. The Demographic Committee is establishing a subcommittee on Index to International List of Causes of Death in Spanish and Portuguese. These merely suggest the extent to which Committee additions and proliferations may be anticipated as the Institute's program progresses.

STAFF

The tremendous distances between national capitals and population centers in the Western Hemisphere give rise to special problems for such an organization as the Institute, affecting both its committees and its staff. A partial solution of these difficulties was initiated by the

Institute's distinguished President, Dr. M. A. Teixeira de Freitas, Secretary General of the Brazilian Institute of Geography and Statistics. Highly placed statistical officers—specialists in selected subject matter fields—are being released by their governments to one year periods of service in the Permanent Office. The governments participating as well as the fields of specialization will presumably be rotated, granted some degree of opportunism, in order to spread the leavening effects which may be expected to flow from the plan. The assignees will not only strengthen the central staff in the Permanent Office but will simultaneously provide staff assistance to the project committees to which their work relates. Other technicians will be added to the group as opportunity permits under a variety of fellowship programs. All of this composite staff will assist in formulating the Institute's varied programs in their particular areas of competence.

The Permanent Office is currently receiving, or will shortly receive under arrangements of this sort already perfected, professional service in residence as follows: From Brazil, a specialist working on comparability of foreign trade classifications; from Peru, an expert working on population censuses, looking toward a hemispheral census in the years 1950–51; from Colombia, a leading agricultural statistician will seek the adaptation to Latin-American countries of procedures for making crop and livestock estimates and for conducting agricultural censuses; from Chile, an expert is expected to work on the statistics of mineral and industrial production. These are in addition to regular staff and project staff appointments. They are also in addition to staff appointments on Institute activities carried on elsewhere than in the Permanent Office.

Thus the Editor of the quarterly journal *Estadística* has been made responsible for his own staff arrangements at the journal's office in Mexico City. The Institute has been served in the field by two part-time representatives, Dr. Forrest Linder whose services have been loaned in connection with other South American work by the United States Bureau of the Census; and Dr. Roberto Guye whose time is shared equally by the Institute and the International Labour Office.

FIELDS OF WORK CONCENTRATION

The creation of the Institute has been widely welcomed by numerous official inter-American conferences and congresses, the felicitous resolutions of which have frequently included requests for Institute attention to a wide variety of statistical issues. The Eighth American Scientific Congress alone, in a series of 15 resolutions, "covered the waterfront"

in a comprehensive enumeration of specific statistical undertakings which were urged as suitable for Institute effort. Since energies would be dissipated if work were attempted simultaneously upon all of these, certain areas of concentration have been agreed to. Some of these have been indicated in the preceding itemization of standing committees. Three principal criteria have affected the selection: first, the relative importance of data; second, the effects upon general statistical improvement to be expected from a given activity; third, the availability of qualified committee and staff personnel.

Hemispheral needs for information and at the same time unfilled gaps in data have seemed to be greatest in respect to population and demography, and basic production in agriculture, extractive and manufacturing industries. Information on trade relations is likewise important. Hence the existing statistics in these areas have been initially chosen for study.

However, a *sine qua non* for any enduring program of statistical activity is a supply of competent professional personnel. Hence another basic area of Institute interest is that for which the Committee on Statistical Education was constituted. The preparation of statistical textbooks in Spanish and Portuguese; the translation where needed of standard texts, manuals and handbooks; and the development of statistical courses in universities and colleges are among the objectives which this committee seeks to advance.

A general leverage for the development of better and more comparable economic statistics is being sought through the *Inter-American Statistical Yearbook* and the project on national income estimates. These require separate explanation.

INTER-AMERICAN STATISTICAL YEARBOOK

Through the pioneering enterprise of Mr. Raúl C. Migone and his collaborators, 1940 and 1942 editions of an *Inter-American Statistical Yearbook* have been published under the sponsorship of the Argentine Commission of High International Studies. Lacking the contacts and facilities which the Institute now provides, the editors of this groundbreaking work were compelled for the most part to utilize data which had previously been collected or assembled and published by other international organizations. In complete agreement as to the desirability of a more direct approach to the task, Mr. Migone generously agreed to throw in his interests with the Institute and to serve as Chairman of the Institute Committee which will continue the Yearbook series. A "dummy" of tables for the revised publication is now in preparation

and work will be carried on hereafter in direct association with the Permanent Office and with the official statistical offices which must supply the basic data. It is hoped that the first volume of the revised yearbook may appear in 1945. But even more important than the appearance of a useful statistical abstract will be the strain towards improvements of standards, toward the widening of activities, and toward increased statistical comparability among the American Nations that will result from preparation of the volume.

NATIONAL INCOME PROJECT

At the request of the Director General of the United Nations Relief and Rehabilitation Administration the Institute has agreed to advise UNRRA and its American member governments concerning their estimates of national income. Governor Lehman's request results from the provision which bases national contributions upon national income estimates. The National Bureau of Economic Research has accepted the Institute's invitation to join in sponsoring and directing the project, which will be placed under the supervision of Dr. Simon Kuznets of the National Bureau staff.

THE QUARTERLY JOURNAL

The first five issues of the Institute's attractive quarterly journal, *Estadística*, have now appeared (on time) from the publication office in Mexico City. Under the energetic and imaginative direction of its distinguished editor, Juan de D. Bojórquez, this journal has adopted numerous editorial departures which are unfamiliar in statistical periodicals. Articles appear in the language of the author, whether Spanish, English, Portuguese or French, with brief multilingual summaries. *Estadística* serves as a medium of communication concerning the affairs of the Institute among its members as well as a vehicle for disseminating statistical articles and notes of general interest. It is hoped that certain current statistical series may be developed for regular appearance in its issues. It is nominally priced at two dollars per annum in the hope that its range of influence may be widely extended.

OTHER PUBLICATIONS

Even before its organization was completed the Institute published through its Temporary Organizing Committee an 842 page compendium entitled *Statistical Activities of the American Nations*. This was intended as an initial guide to the statistical services of the 22 American Nations, and was also nominally priced at two dollars with

a view to wide distribution. It is extensively and constantly in use by Government agencies and others concerned with inter-American affairs. A small descriptive brochure entitled *The Inter American Statistical Institute: Origin—Organization—Objectives* has recently been reissued in a second, revised edition. A *Biographical Directory of Statistical Personnel* in the American nations has also been published and is under current revision.

MICROFILM SERVICE

Arrangements have been completed with the Coordinator of Inter-American Affairs for the monthly airmail distribution by the Permanent Office to the *Dirección General de Estadística* in each American country of microfilmed material of general statistical interest, carefully selected and ingeniously indexed for use and handling. This service is the particular brain-child of the Secretary General, Dr. H. L. Dunn. Reading machines are to be provided by the Coordinator's Office and it is hoped that the service will soon develop into a two-directional exchange. Data and source documents which would not otherwise reach them promptly, if at all, will come quickly and conveniently to hand in every key statistical office of the hemisphere. This will include much unpublished material pertaining to the organization and procedures of statistical activities in all of the American Nations. Only those who have fruitlessly sought to obtain them will appreciate how difficult it is to secure copies of basic schedules and instructions employed in the statistical inquiries of other countries. The use by business and government of *teletype* communication will find here a realistic analogue.

A GENERAL APPRAISAL

The creation of the Inter American Statistical Institute has evidently served a genuine need, not elsewhere satisfied. The evidence of this is found in its lusty growth and the already heavy demands upon it from many sources for information, assistance, and advice. No one has been more surprised by this than the midwives who attended its birth. Instead of being called upon to conserve a feeble flicker of vitality as they might have expected, these original functionaries are now pulled along by a youthful prodigy in full stride. Whether growth in stature and weight will continue after the war will depend, in my judgment, upon the Institute's preservation of two basic and original characteristics: First, it is an *active* instrument for statistical advancement in the Western Hemisphere; second, it is under the domination of no single American Nation, but belongs equally to all. At age four there seems every promise that these twin conditions of healthy survival will be maintained.

WAR TIME FACTS AND PEACE TIME NEEDS

By Vergil D. Reed
Associate Director of Research, J. Walter Thompson Company
Formerly Chief, General Statistics Staff, War Production Board

It is the duty of every statistician, market research man, business executive and economist to see that dead files do not become the graves for the living and useful facts collected by the war agencies. It is none the less their duty to make certain that a rational minimum statistical program is assured for peace time, that the emotional upheaval when peace comes does not blind us to the necessity of facts for the readjustment period and the more distant future. The best the war agencies have done must be saved. The unbroken continuity for what is worth continuing must be assured. War time series must be adapted to peace time needs and incorporated into a planned statistical program to replace the hodgepodge of unrelated current data that existed before the war.

After World War I and after the dismantling of the National Recovery Administration (1936), a great hoard of industrial and distribution statistics was filed away to gather dust and mold. This was a tragic and unforgivable waste which we cannot afford to repeat.

In 1917, United States *industry expanded* to include war production *instead of converting* to produce war goods. In the present "total" war, extensive and rapid *conversion, as well as vast expansion, was necessary.* Our normal industrial economy has, therefore, become distinctly abnormal for the duration of the present war. The problems of reconversion to a peace economy will be vastly greater this time. Those problems will require sound judgments based upon detailed facts. Ours is no longer a simple economy wherein responsible business or government executives can carry all the necessary knowledge under their hats or depend upon ingenuity and experience alone to make good decisions.

Modern war brings astounding changes in the economics of nations not even directly engaged in hostilities. For those actually engaged, the dislocations imposed upon their production, distribution, and consumption patterns present industry and government alike with a series of problems so complex that only a careful evaluation of cold, hard facts and their application with vision as well as knowledge can give a basis for prosecuting the war and guiding our post-war readjustments.

We have excellent basic statistical information in considerable detail for our pre-war economy. All of this was available to business and industrial interests. Fortunately our 1940 Census gave us a complete

inventory of our minerals production, agriculture, population and labor, housing, manufactures, distribution and services just prior to our entry into the war. These data were extremely helpful in setting up our Selective Service System as well as in converting our industry and quickly translating our resources into ships, planes, tanks, guns, armies and supplies to make their operation effective. Our production had to be on a scale startling even to North Americans, the apostles of mass production.

To attain the vast production needed there had to be direction and coordination of our industrial resources and efforts. That function fell, and still falls, largely upon the War Production Board. Data already available were invaluable as a basis for decisions on policies and plans to be adopted upon our entry in the war. However, it has been necessary to request from industry and keep current a vast amount of timely facts in greater detail for the purposes of direction of effort and measurement of results.

Conversion of plants, plant utilization, scheduling of production, administration of restrictive orders, allocation of materials and manpower, stockpiling, redistribution of equipment and materials, salvage, contracts, construction and requirements—all required a steady flow of current facts. Statistics, and the questionnaires through which they are secured, are an inevitable burden in any intelligent centralized direction and control by government or by business itself. The only alternative is the tragic one of basing judgments, policies, and plans on a combination of intuition, experience and "hunches."

The collection of the facts necessary for the prosecution of the war has resulted in a real hardship and some irritation to industrial concerns during a period of manpower shortage, particularly as to technical and clerical staff. The exasperation of respondents was easy to understand. The need for the data was extremely pressing. The number of necessary questionnaires increased greatly. Many of the additional questionnaires came from regulatory agencies. Practically none of the compilations of resulting data could be made available to business since they were classified as "restricted," "confidential," or "secret," for military security reasons. Industry was receiving no dividends of information on its heavy investment in facts furnished the Government. Ironically, the business man was suddenly deprived of current data at the time when he felt he needed them most and when he was being asked to contribute far more to the total fund of industrial knowledge.

The restrictions were accepted by industry at first as a military neces-

sity in spite of the handicaps they involved for management. However, as the war progressed and our output grew past the stage of critical shortages, the demands by business organizations, trade papers, research groups, and individual companies became more and more insistent to make greatly needed current facts available to business again.

Believing that our prosecution of the war had reached the point where some of the rigid restrictions on industrial data could be removed, and that making them available to business again would not only be helpful in attaining our maximum war output but in planning for post-war readjustments, the following recommendations were made by the Chief of the General Statistics Staff to the Chairman of the War Production Board in September 1943:

1. That War Production Board policies be liberalized to provide industry regularly with current data from the vast amount of statistical material collected by WPB. Management's needs for basic industrial facts are even greater in war than in peace, yet access to such facts is largely denied at present.

2. That such statistical series or reports be distributed to trade papers, trade associations, the Department of Commerce, the U. S. Chamber of Commerce and the Committee on Economic Development. These organizations should be encouraged to give such facts wide circulation. This procedure would assure wide dissemination with the minimum of WPB man-hours expended in publication.

3. That an agreement be made immediately with the Department of Commerce with the approval of the Bureau of the Budget under which any existing statistical series before being discontinued by WPB would be referred to the Department of Commerce for its consideration as to the desirability of continuance by the Department without breaking the series. This agreement should be made now, regardless of when the war or any part of it ends. Other organizations such as the Bureau of Mines, the Tariff Commission and the Forest Service have vested interests in certain series which should be given similar consideration.

4. That steps be taken in cooperation with the Bureau of Mines to make public through its Minerals Year Book the minerals production series formerly carried in it, excepting only those few minerals the major portion of which are imported, or the disclosure of which would actually give aid and comfort to the enemy. Disclosure of the data on most of these minerals should be most discomforting to the enemy.

5. That the advice of the Industry Advisory Committees of WPB be sought as to the statistical series which should be continued after the war.

6. That those series now being collected and tabulated by the Bureau

of the Census for and at the expense of the WPB be published jointly by the Department of Commerce and WPB. This would assure continuity without confusion by simply withdrawing the name of WPB on any series when WPB desires to withdraw. The Department could prepare and make the releases. WPB would retain the right to review and approve releases, so long as its interest in the series continues.

7. That the first release of any series be submitted to the Security Officer for clearance and approval as to security.

8. That all releases made exclusively by Divisions or other units of WPB be made through regular Division of Information channels and that the head of the issuing unit be responsible for the statistical accuracy of the release but not for the security status of the data.

These recommendations were accepted by the Chairman of the War Production Board without change, and accepted by the Division of Statistical Standards, Bureau of the Budget, in principle. Procedures to put the plan into effect were readily agreed to by the Bureau of the Budget and other cooperating Government agencies involved. These procedures will be covered later in this paper.

Very soon after adoption of these recommendations it was found desirable, and mutually agreed, that even releases prepared entirely by the WPB should be processed and distributed for the Board by the Bureau of the Census rather than by the Division of Information of WPB since that organization's main interests lay with newspapers rather than with trade papers and business organizations.

Two types of data are being published. Current data collected on a monthly or quarterly basis constitute the major contribution. These are released as continuing series with the primary release showing base data for as many annual periods as are available and which conform to certain statistical standards. In many cases these series may even be "tied" to Census of Manufactures data for 1939, the last year for which such a census was taken. These initial releases, besides establishing a base for the series, carry the periodic figures up to date. Subsequent releases in each series will be monthly or quarterly depending upon the time intervals covered by the reports required from the industrial plants covered.

The second type of data to be published comes from, or may include all significant facts collected in certain "one time" statistical reports or surveys made by the War Production Board or by other agencies for the War Production Board. Examples of this type of release are (1) "A Survey of the Printing and Publishing Industry," made for WPB by the Bureau of the Census, (2) "Production and Distribution of Commodities under the Controlled Materials Plan," prepared within WPB,

and (3) "Lumber in the War Program 1940–43," done by the Census Bureau for WPB.

Certain studies of special problems involving the consolidation and analysis of data from several sources may also be published. The variety of subject matter available for publication is great. The amount of data available and the time period covered, however, vary for the different commodities, functions, and categories. For many of those items which were critical at the beginning of the war, or previous to our entry, excellent detailed information is available over two or more years. In other cases the collection of current data was not undertaken until critical situations arose later or the establishment of controls became necessary. In some cases studies or surveys of an entire industry were made. Sample surveys of consumer requirements have also been carried out. Production, shipments, consumption, stocks and requirements had to be measured for many materials, components, and end products ranging from abaca to zinc.

A few examples from series already released best indicate the types of data available and the value they have to business and other users of statistics. These include:

1. Aluminum Castings: Monthly Shipments by Type
2. Aluminum Ingot: Monthly New Supply
3. Aluminum Fabricated Products: Monthly Shipments
4. Magnesium Ingot: Monthly Production
5. Magnesium Fabricated Products: Monthly Shipments
6. Automotive Replacement Type Storage Batteries: Quarterly Shipments
7. Motor Trucks and Truck Tractors: Annual Production 1940–43, Monthly Production 1943
8. Electric Lamps and Bulbs: Quarterly Production and Shipments
9. Dry Cell Batteries: Quarterly Production 1940 and 1943, Quarterly Shipments 1943
10. Cutlery: Quarterly Production and Shipments
11. Photographic Film: Quarterly Production and Shipments
12. Domestic Ice Refrigerators: Quarterly Production and Shipments
13. Chemicals (by many specific items): Production, Consumption, and Stocks 1941–43 and Monthly Production, Consumption and Stocks
14. Metal Cans: Monthly Shipments, by Product to be Packed
15. Softwood Plywood: Monthly Production, Consumption and Stocks
16. Home Canning Supplies: Jars, Closures, and Sealing Rings Produced, Oct. 1, 1940–Sept. 30, 1943
17. Pulp Mills and Paper and Paperboard Mills (Census, 1942 and 1943)
18. Softwood Plywood: Monthly Production, Consumption and Stocks
19. Paper and Paperboard: Monthly Production, by Type

20. Asbestos Textiles: Allocations by End Use—Last 3 Quarters 1943
21. Metal Cutting Tools: Monthly Shipments and New and Unfilled Orders
22. Machine Tools: Monthly Shipments and New and Unfilled Orders
23. Lumber in the War Program: Production, Deliveries, Military and Civilian Consumption, 1939–43
24. Industrial Diamonds: Annual Imports 1929–40, Quarterly Sales 1941–43
25. Waste Paper: Receipts and Inventory, 1941 to October 1943
26. Safety Equipment: Distribution 1943 and Requirements for 1944
27. Cotton and Rayon Mill Production and Unfilled Orders, by Types, Quarterly
28. Portable Electric and Pneumatic Tools: Shipments, New and Unfilled Orders, 1942–43
29. Containerboard: Monthly Inventory at Converting Plants by Type of Board and Zone
30. Shipping Containers, Corrugated and Solid Fiber: Monthly Shipments by Rating Pattern, July 1943–January 1944
31. Woolen and Worsted Woven Fabrics, by Types, Production, by Quarters
32. Men's, Youths' and Boys' Dress and Work Clothing: Garments Cut and New Orders Accepted, by Types of Garments, by Quarters
33. Cattle Hides, Producers and Dealers Report of Production, Purchases, Sales and Stocks, by Months

Although such series do not give a complete picture of all industry, as is true of a census, they do for the first time since we entered the war, afford a factual view of many of its segments. The list does not include all series being published. Others will also be issued as the data can be prepared.

To assure reasonable standards, certain criteria are used to determine whether or not publication is advisable. The first of these is probable usefulness of the data to business men, economists, and research organizations. Significance and the possibility of drawing sound conclusions from a series outweigh mere statistical perfection, provided that the limitations and short-comings of the data are reasonably well known and can be called to the attention of users so that they will not be misled. How seriously do faults distort the final results? Of what magnitude are the probable errors and exclusions? In other words, are the data accurate enough for most purposes for which they will be used?

It must be kept in mind that most of our present statistics were collected under emergency conditions and the resulting pressures for speed; decisions had to be made on the basis of facts which could be made available quickly on critical questions. The result is that there

are many data in WPB which met and are meeting our immediate operating needs but which are not of sufficient accuracy or completeness to justify publication for other uses. Some of these may be improved later to the point where they can be published. Others will never be published. In certain instances series will be released which are admittedly incomplete because they are the only data or the best available anywhere on a critical subject.

Definitions of the items and subject matter covered in each release must be specific as to what is included, what is excluded and what is most pertinent. The coverage of the series or report as to number of plants or companies, and percentage of the total industry covered in terms of production, shipments, scheduled output, or other such categories must be shown. Comparability of coverage through the time period involved and the extent and time of variations will be stated.

The sources of the data, the methods of collection and compilation used, and relationship to other series will be checked. In the case of joint releases with other government agencies all data must be checked and approved by both agencies involved. Credit must be given for any data included from other sources. No forecasts based upon probable or possible policy changes of WPB can be issued.

Geographic distribution of plants covered, if significant to the practical use of the series, should be shown when possible. Disclosures of the operations of individual plants or companies are to be avoided except with the written permission of the disclosed respondent. Standard industrial and commodity classifications are to be used whenever possible.

The Chief, General Statistics Staff, was given the responsibility and authority to establish procedures and issue instructions for implementing the new WPB policy of releasing industrial data to the public. These procedures are outlined below.

A complete inventory of all questionnaires or data requests and related forms in WPB was made by the General Statistics Staff. The information was classified, analyzed, and compiled into a book *Analysis of Use of WPB Forms: Coverage, Methods, and Contents.* Approximately 450 copies of this book were published mainly for official use. They were practically all "spoken for" before they came off the press. A revised version of this book has been published and is available from the Board upon request.

Of the total forms studied 508 were classified as data requests or questionnaires. The information reported by respondents on these 508 forms is grouped below into 10 specific categories with the number of forms upon which each appeared:

1. Capacity	70
2. Production	
(a) Actual	204
(b) Scheduled	111
3. Shipments	271
4. Consumption	181
5. Receipts of Accepted Deliveries	178
6. Inventory	339
7. Orders	
(a) Unfilled	147
(b) New	119
(c) Cancelled	52
8. Requirements	102
9. End Use Pattern	128
10. Others	151

Other information compiled on each form included: title of form, related order, frequency of return, due date of report, class of respondents, number of respondents, estimated coverage, type of form, whether or not tabulated, form in which summary data are presented, and persons to whom data are regularly presented. This book is the key to all data available in WPB. Perhaps, the suggestion that other war agencies furnish such a key to their wealth of data is in order.

All series and reports falling under the plan are to be known as the "Facts for Industry" Series. They are to be issued in a standard format (See Chart) which is readily recognizable and which identifies the WPB Division and the collecting agency, if any, the series, and the individual release within each series. The family resemblance and identifying numbers result in ready recognition, easy filing, quick reference, and definite allocation of responsibility.

All proposals for the publication of statistical data are initiated by or submitted to the Chief, General Statistics Staff, who is responsible "for obtaining agreement on the technical validity and adequacy of the data, for obtaining any necessary agreements and clearances within the War Production Board and with other government agencies, and for authorizing the discontinuance of any series established."

The initial release in any series is submitted to the Bureau of the Budget which is responsible for obtaining all military security clearances. Subsequent releases within a series are finally approved for publication by the General Statistics Staff.

Agreements may be made with other government agencies through Budget Bureau assistance whereby statistics collected by them for

CHART

WAR PRODUCTION BOARD
Forest Products Bureau

U. S. DEPARTMENT OF COMMERCE
Bureau of the Census

For Release on
January 12, 1944

"Facts for Industry"
Series 16-1-2

SOFTWOOD PLYWOOD

Production, Shipments and Stocks of Softwood Plywood, and Consumption and Stocks of Materials, October–November 1943

Item	November 1943	October 1943	November 1942

WPB or regularly compiled by them but preempted by WPB may be issued jointly by WPB and the collecting agency. Preparation for publication is to be done by the collecting agency but such joint releases are cleared by the General Statistics Staff with the sponsoring Division in WPB. Joint releases are issued and distributed by the collecting agency. WPB retains the right to review and approve all such joint releases, so long as its interests in any series continue.

The collecting agency, excepting WPB which publishes and distributes its releases through the Census Bureau, is responsible for the actual publication and distribution of all approved releases and keeps a record of media to which releases are sent.

Correspondence requesting technical explanations or interpretations is referred to the Division or other unit within WPB responsible for the series to which the correspondence refers, or to the collecting agency in the case of joint releases.

Proposals for discontinuance of a series must be approved by the General Statistics Staff. The proposal must be submitted sufficiently in advance to allow transfer of the series without interruption, to some other Federal agency should the Bureau of the Budget and the agency involved decide that continuance is desirable after WPB has no further need for the data.

The "Facts for Industry" series affords an excellent example of what can be accomplished through the cooperation of various government agencies. Little additional burden is put on any one of them, yet a very appreciable volume of related and coordinated data can be made available and each agency is assured proper recognition for its contributions. The nature of the releases makes this cooperation apparent to the public. Represented in this cooperative effort are such diverse government agencies as: The War Production Board, The Department of Commerce (Bureau of the Census and Bureau of Foreign and Domestic Commerce), The Tariff Commission, The Bureau of Mines, The Forest Service, and the Bureau of the Budget (Division of Statistical Standards). In addition, several private organizations such as the United States Chamber of Commerce, the Committee on Economic Development, trade associations and trade paper editors have pledged their cooperation in the wide dissemination of the data.

Other government agencies are being encouraged to take similar steps to secure the release and publication of data which they have collected during the war, even though the War Production Board may have no official interest in their particular fields.

Both private and government agencies having responsibilities and interests in post-war planning or readjustment can be much more effective and realistic in their work through using the facts being made available. If industry and business secure immediate benefits from the statistics already collected; if they have the opportunity to judge, and weigh, and evaluate their usefulness, much more intelligence will be used in choosing those which should be continued after the war. Industry will cooperate actively to save and improve those series which it has already found valuable, but it cannot be expected to advocate continuing series which it does not know are in existence and which it has had no opportunity to judge as to usefulness. It must always be kept in mind that those in industry are respondents as well as users. No amount of compulsion in reporting will attain the quality or completeness of returns which cooperation based on an appreciation of usefulness brings with it.

Publication of the "Facts for Industry" series removes WPB from the untenable position of denying to business and industry useful facts which it already has in its possession, and which admittedly in most cases are the only facts available showing what has happened to industries and commodities since we entered the war.

Needless duplication of effort and duplicate reporting by respondents can be avoided through publishing these data. Many trade associations

have found it necessary to duplicate the collection of data from their industry members. They could not get them from WPB, although in many cases the desired facts were already collected and tabulated, but could not be released. Many of the criticisms and contradictory statements in the trade and daily press, which tend to confuse the public, have resulted from the lack of availability of official facts. These facts, if known, at least in many cases, would justify the policies and decisions of WPB at the same time they would enlighten management on its present and future planning. This means better public relations and better industrial relations as well as additional services rendered to business. An enlightened public is apt to be a more cooperative public.

The War Production Board has taken, in its "Facts for Industry" series, the first step to avoid a recurrence of the regrettable demise and burial of useful data which followed the last war, and has assured business of useful current data for present operations. There are many more facts in many more war agencies. The next steps seem clear. The responsibility for their being taken falls squarely on the shoulders of those who need the facts—you and I and he and she. . . .

CENTRALIZED INTERNAL CONTROL OF DATA COLLECTION BY FEDERAL AGENCIES

By Edward T. Crowder
Bureau of the Budget

There is now considerable familiarity both within and without the statistical profession with the control exercised by the Bureau of the Budget over the collection of data by agencies of the Federal government. There is no doubt less general familiarity with the internal procedures within various Federal agencies which have been designed to provide internal statistical controls analogous to that provided for the Federal government as a whole by the Bureau of the Budget. In a recent report[1] the Bureau of the Budget pointed to the existence of some fifteen internal control offices, through which flow the great bulk of the report forms submitted to the Bureau for final approval.

These internal control mechanisms are significant not merely with relation to the swollen volume of wartime reporting to the Federal government, but also with respect to the longer range problem of introducing a maximum of efficiency and order into the Federal statistical program. It is the purpose of this paper to discuss briefly their development in recent years; the conceptual basis for such control; and some of the actual problems involved in the establishment and operation of control offices.

The development of internal statistical control is best understood against the background of the government-wide program of statistical coordination and control which has been developed by the Division of Statistical Standards of the Bureau of the Budget (and from 1933 to 1940 by its forerunner, the Central Statistical Board). This program has sought to improve, and to introduce a maximum of order and efficiency among, the highly decentralized statistical services carried on by the various Federal agencies. The Bureau's authority and responsibility as a statistical control agency has recently been given specific legislative endorsement by the Federal Reports Act of 1942,[2] which is aimed at the elimination of duplication in Federal data collection, the reduction of the reporting burden on the business community, and increased efficiency in the collection and use of Federal statistics. Much of the activity of the Division of Statistical Standards has consisted of the review of specific plans for the collection of data from the public,

[1] "Report of Progress under the Federal Reports Act," in *Congressional Record*, March 16, 1944, Vol. 90 (Temp. file), p. 2691.

[2] "An Act to coordinate Federal reporting services . . . ," Public Law 831, 77th Congress, 2d Session, Approved December 24, 1942.

which plans must, with certain exceptions, be approved by the Bureau before adoption. Approved forms or questionnaires are assigned "Budget Bureau approval numbers" to aid the respondent in distinguishing authorized from unauthorized inquiries.

A fully developed internal control office within a Federal agency should perform within that agency a statistical control function analogous to that of the Bureau of the Budget. It should approve each questionnaire, reporting requirement, or other means of collecting data from the public before the final approval by the Bureau of the Budget is requested. It should undertake a substantive review of the proposals sent to it and be responsible for internal clearance of projects of interest to more than one part of the organization.

Internal control of this sort has had a tardy development. On the basis of a survey of Federal report forms used in 1938, the Central Statistical Board observed that:

> Only some half a dozen agencies have either developed, or are now in the process of developing, orderly methods of reviewing their own questionnaires and report forms, and of keeping records concerning the adoption and use of forms to collect information from the public. The general lack of centralized authority for and even of basic records on report forms in Federal agencies is undoubtedly one reason for some of the duplications in Federal reporting requirements. Moreover, this lack of centralized authority is a contributing factor in the accumulation of unnecessary burdens upon respondents.[3]

The Board recommended legislation requiring the keeping of uniform records on the collection of data from the public and the centralization within each agency of responsibility for authorizing questionnaires and report forms and for maintaining the required records.

A powerful impetus in this direction has come from the present war. Priorities and allocations, price control, economic warfare, selective service, military and naval procurement, and other phases of governmental defense and war activity involved the collection of great quantities of data which the government had not previously had occasion to require. Much of this data collection was necessarily carried on by newly assembled personnel, sometimes in newly established organizations. A critical problem of coordination and control arose which was emphasized by the mounting resentment by the public of the avalanche of government questionnaires.

The problem was not unrecognized by the agencies themselves, and

[3] *Report of the Central Statistical Board on Returns Made by the Public to the Federal Government*, House Doc. No. 27, 76th Congress, 1st Sess., p. 24. For a brief reference to the internal clearance arrangements which had been worked out within the Department of Agriculture, see the *Fourth Annual Report of the Central Statistical Board, July 1, 1937, to June 30, 1938*, p. 6.

by the summer of 1942 internal control mechanisms had been established within the four agencies responsible for the largest volume of data-collection projects (the War Production Board, the Office of Price Administration, and the War and Navy Departments). The appreciation of the problem among government agencies was increased, moreover, by the adoption by the Bureau of the Budget of the "approval number" system (August, 1942) and the passage a few months later of the Federal Reports Act. The Bureau of the Budget subsequently required in its clearance regulations that no project be submitted to the Bureau for approval until it had been discussed with all interested units within the sponsoring agency and all unnecessary duplication eliminated.

The response to the "questionnaire problem" by the Federal agencies has varied according to the nature, size, and newness of their data-collection programs, the extent of their previous development of internal coordination procedures, and their realization of the need for internal coordination. In March, 1943, the Bureau of the Budget announced in a press release that ten agencies had set up internal control units, while several others had informal arrangements for internal clearance. In its latest announcement on this matter (in the "Report of Progress" cited above) the Bureau pointed to fifteen such control units, through which flow 90 per cent of the forms presented to the Bureau for approval.[4]

As a measure of the current development of internal control within Federal agencies the above figures must be interpreted with caution. Though most agencies have not been recognized as having control offices, the smaller the volume of data collection by the agency and the smaller the likelihood of duplication or conflict among programs, the less pressing is the need for special questionnaire control facilities. There are perhaps agencies where such facilities are not necessary. On the other hand, the degree of actual control exercised by the recognized control offices varies widely, and many projects receive little if any real substantive review. Within a few agencies internal control has had a considerable development, but we are still very far from the effective internal control of reporting programs among the agencies as a whole.

Existing control offices vary in their location within their respective agencies. In the Department of Commerce a special Assistant to the Secretary has a general responsibility for statistical coordination and

[4] The Bureau has recognized the existence of a control office only when there has come to its attention a special procedure which is capable, in the Bureau's opinion, of yielding an appreciable amount of control and coordination. When control offices exist at different levels in an organization, only the "top" office has been counted.

review. In the Department of Agriculture control authority has been given to the head of the Bureau of Agricultural Economics, and delegated by him to a review officer, who draws on the technical staff of the Bureau for assistance. The "Statistical Standards Branch" of the Office of Price Administration is located in the Administrative Management Department. The "Office of Survey Standards" of the War Production Board is in the Bureau of Planning and Statistics. There appears to be a tendency for the statistical control function to be associated with administrative controls as well as with statistics and research.

Control units vary also in structure, size, procedure, and philosophy. The staff engaged in actual review may consist of several persons or of only one. Review may be intensive or may be concerned only with more general issues. Control offices vary in the degree of responsibility which they assume for negotiations with the Bureau of the Budget in order to obtain final approval of a project.

The Bureau of the Budget, while encouraging the development of internal control offices, has not recommended uniformity in their organization or procedures. It has taken the position that arrangements appropriate to one agency may not necessarily be appropriate to another. It has favored the issuance within an agency of an order designating a clearance office with authority to approve data-collection proposals, and the employment of high grade professional staff members to perform the review work. When problems have arisen within particular agencies the Bureau has from time to time made specific recommendations.

The decision to provide for the review of data-collection activities by a special control office represents a recognition of the peculiar importance of data collection and of the fact that, like position classification or budget planning, it should be subject to special treatment. Just why this is so has not been obvious to those who have been inclined to think that data collection should be controlled only through the normal channels of supervision within the agency. The case for a special control procedure may be seen from an examination of the responsibilities appropriate to statistical control units.

The most obvious field for the activity of a central control office is that of coordination aimed at avoiding duplication of data-collection activity within the agency, at insuring that whatever data are collected have a maximum usefulness to the whole organization, and at insuring consistency among related programs sponsored by the agency. Division A should not collect for its own convenience data which Division B has already collected in a somewhat different, but nevertheless adequate, form. A survey should be so designed as to be of maximum

value to all interested branches. Related programs should be as consistent as possible with respect to reporting units and reporting periods. Coordination of this sort does not necessarily occur within a large organization if reliance is placed on ordinary channels of control or on the spontaneous cooperation of program directors. But the greater the extent to which the program of a single agency involves more than one type of contact with a given respondent group or involves the collection of related statistics through different channels, the greater will be the need for internal coordination. It is clearly more appropriate that it be brought about through an internal control mechanism than that it be imposed by an outside agency.

A second important task for an internal control office is to insure that no more information is sought from respondents than is reasonably necessary. This function derives its importance from the apparent tendency to seek to collect by means of questionnaires or report forms information which either is already available or is not sufficiently necessary to justify the expense and trouble, both to the government and to the respondent, which would be required to obtain it. This tendency is apparent not only in the planning of unnecessary reports but also in the over-elaboration of necessary inquiries, in accordance with what might almost be called a natural "law of the expansion of questionnaires."

The information available to the government for the asking is not unlimited in quantity since it may become available only through the use of scarce resources (particularly personnel) in the offices of the respondents. The answering of an important inquiry may easily be delayed while the respondent answers a less important one which he has received earlier. (Indeed an unduly elaborate questionnaire may defeat itself if the less important questions interfere with a prompt reply to the more important ones.) Central control offices must determine precisely what use will be made of specific information and must reach judgments as to how far it is worthwhile to pursue particular investigations. Any weeding out of the less necessary data requests which can be brought about through internal review should be so brought about and not left to an outside control agency.

Finally, an internal control office may perform a valuable service by enforcing specific standards or policies which may have been adopted relative to data collection and by insuring the statistical and administrative adequacy of reporting projects. There is much that can and should be accomplished by internal review rather than by intervention from the outside. For example, a central control office can insure that all forms fit a standard typewriter; that reporting instructions and

column headings are clear; and that sampling procedures are sound. In reviewing the adequacy of a reporting proposal the control office would not, of course, presume to know more than the sponsors about the specific problem giving rise to the proposal. However, a skilled review staff, with a background derived from contact with a variety of reporting projects, should be able to offer a specialized knowledge of data-collection techniques and problems.

Certain problems seem to be inherent in any attempt to institute internal questionnaire control within individual Federal agencies. One of these arises from the attempt sometimes made to draw a clear line between matters with which a questionnaire control unit is properly concerned and "policy" matters, with which such a unit should not, it is argued, concern itself. This constitutes a problem because data collection may (quite properly) be very closely related to policy. In many cases, in fact, data collection is part of an administrative procedure (as, for example, in application procedures). The need to ask a given question in a given way, of a particular group of respondents, with a particular frequency, may appear to be purely a matter of policy and properly exempt from review by a questionnaire control unit. For example, the decision to reappraise a regulatory program at frequent intervals may seem to dictate a given frequency of reporting. Or detailed reporting by all persons covered by the regulations may seem necessary to insure compliance.

The most feasible approach to this problem is to cease trying to distinguish between data-collection problems and policy problems. A questionnaire control office is properly concerned with the feasibility of a data-collection program and its appropriateness to the objective in view. If the objective will be more effectively attained by revision of the data-collection program, no conflict with "policy" need arise. But if a given policy is so tied up, not to say identical, with a given reporting program that any tampering with the reporting program involves meddling with policy—then it would appear that a review by the questionnaire control unit is more, rather than less, necessary. A policy which stands or falls with a vulnerable reporting program is a vulnerable policy. In such a case review by the questionnaire control office should be carried on with discretion and with due consideration of all factors, but it should not be waived.

A second problem arises from the tendency for the control function to become confused with service functions. This is natural because the work of a control office extends into certain areas which may be regarded as services to the sponsors of plans—for example, form design

and editing, clearance with other interested units, and liaison activity with the government-wide questionnaire control agency.

Surely no control unit should lose sight of the fact that its function is to serve the agency, but the control function must be frankly recognized both by the control unit and by the organization as a whole. Disguising the control function as service may result in unnecessary resentment and resistance when real control must be exercised. Moreover, the effectiveness of the clearance office may improperly be judged by its popularity. Questionnaire control is not simply a service to the controlled units and, even when carried on with a maximum of skill and tact, is inherently unpopular.

A very difficult problem of statistical control arises if an agency establishes field offices which are expected to collect information from time to time on their own initiative. Clearance with the central office is difficult at a distance, and in emergency situations may be inappropriate.

When central clearance is clearly impossible without jeopardizing an operating program, waiver of review or delegation of authority to someone at the scene of the operation is advisable. Thus the central control office of the Office of Price Administration has, with the concurrence of the Bureau of the Budget, dispensed with a preliminary review of projects originating in the Territories and performs only a post audit. There are perhaps other areas in which waiver or delegation of authority is preferable to central clearance. But the danger of unnecessary and uncoordinated collection of data is surely no less present in field offices than in central offices, and the decision that clearance is not feasible should not be reached too quickly and without exploring other alternatives. One such alternative is central *advance* planning, wherever feasible, of the forms and reporting requirements to be used throughout the field. Another alternative is the working out of emergency clearance machinery whereby the general outlines of a particularly urgent proposal are communicated by wire to the central office, which undertakes to act with unusual promptness if the emergency is a real one.

Another problem inherent in internal questionnaire control is concerned with the time at which the review of a given project should begin.[5] If review occurs only at the final stage of planning, when schedules have been designed and administrative arrangements are under way to carry out the project, the function cannot be properly exercised. Any

[5] The problem of timing (as well as certain other aspects of centralized control) has been discussed with special reference to the review activity of the Bureau of the Budget by Luther Stringham in "Government Questionnaires and the Federal Reports Act of 1942," *Public Administration Review*, Vol. III, No. 2 (Spring, 1943), pp. 150 ff.

basic revision made so late in the planning of the program may have serious consequences—so serious in fact that it may be better to approve a defective plan than to attempt to improve it.

The solution to this clearly lies in maintenance of sufficiently close relations between the review and the planning staffs to insure that any major issues are raised early and resolved without jeopardizing a program through last-minute delays. In maintaining this intimate contact, the review staff must be careful not to participate in the planning in such a manner that it loses its objectivity. Any tendency for operating staffs to "borrow" reviewers temporarily to assist in the preparation of plans must be regarded as potentially dangerous to the adequate performance of the control function.

Some insurance against the discovery of unresolved major issues at the final stage of planning lies in the advance announcement of standards to be applied. Certain control offices have prepared for use within their agencies statements of such standards.[6] Standards expressed in general terms may also be found in internal directives dealing with clearance procedures.

Such statements have a distinct educational value. To the extent that they deal in a definite manner with specific issues they may settle questions in advance of actual review. But the usefulness of this device as a preventive should not be exaggerated. Clear and specific statements of policy are fairly easy to formulate with reference to such minor (although necessary) rules as those concerned with format and size. The farther we move into the more difficult problems of insuring clarity and statistical adequacy and avoiding unnecessary questions, any statement of standards tends to become more and more generalized. These generalities, while highly useful, cannot take the place of review of specific projects.

Still another problem concerns the desirability of establishing within an organization a hierarchy of review offices such that a given project is subject to review at one or more levels prior to formal submittal to the control office for the agency as a whole. To the extent that such pyramiding of review represents an awareness of the need for statistical control and to the extent that it is productive of a higher quality of planning, it deserves nothing but commendation. Multiple review within an agency does, however, create a problem of timing. If different reviews must be accomplished successively the loss of time may be so

[6] A thirteen-page pamphlet entitled *Criteria for the Review of Public Reporting Forms and Surveys* and a twenty-page *Questionnaire Manual* have been issued by the OPA and the WPB control offices, respectively. A shorter statement has been issued for use within one division of the Office of Education.

great as to outweigh the benefits of the more thorough review. The solution is to be sought in concurrent review so that by the time a project is ready for approval by the agency control office all issues will at least have been raised, if not settled.

The fact that projects reviewed by an internal questionnaire control office must usually receive the further approval of an outside control office raises additional problems. One of these concerns the degree of responsibility which the internal office assumes for the standards which it enforces. In the face of the control exercised by the Bureau of the Budget it is easy within a given Federal agency to enforce a control program by emphasizing the standards imposed from without. The convenience of such a device, particularly when the philosophy of internal control is not generally accepted within the agency, is undeniable. However, it remains true that the cause of statistical coordination and control is greatly advanced whenever an agency head establishes on his own authority and independently of any outside control a set of standards and a control procedure concerned with the data-collection function.

Another problem arising from the coexistence of internal and external controls is concerned with timing and the avoidance of duplication in the review process. This is analogous to the problem of multiple review within the agency. If external and internal review were identical in scope and purpose, review and approval by a competent internal unit might be a sufficient basis for perfunctory approval by the external office. But a reporting program which from the point of view of a single agency is unobjectionable may be regarded as too burdensome in the light of other reports required of the same respondents by other agencies or may involve a very serious problem of interagency coordination. For these reasons two reviews are in many cases inevitable and the problem is to find techniques for effecting them promptly without loss of time and without duplication of effort. Experience seems to indicate that the ideal plan is one involving coordinate review and some division of labor. Under such a plan both the external and the internal review offices would examine a proposal concurrently. The external office would discover and pursue the issues which were important to it, leaving to the internal office the pursuit of issues more appropriately resolved internally.

A number of other questions might be discussed—for example, the proper location of the control office within the organization, its relation to the function of general statistical planning, its responsibility for detailed matters of form design, and so forth. But the above discussion

is sufficient to indicate the variety of problems involved in the development of this relatively new phase of administrative control within Federal agencies.

Much valuable experience is now accumulating through the functioning of the existing internal control units, and additional units may be established. Though much of the impetus toward internal control has come from the wartime expansion of the Federal statistical program, it is not unrealistic to hope that internal control units will survive the war on the basis of their tested usefulness. Too much should not be expected of them. They should not be thought of as a substitute for proper internal organization or for competent statistical personnel within their agencies. Rather they should be looked to for that coordination, perspective, and specialized knowledge of data-collection problems which it is their function to provide.

METHODS USED IN PROCESSING DATA FROM THE PHYSICAL EXAMINATION REPORTS OF THE SELECTIVE SERVICE SYSTEM

By Thomas I. Edwards and Louis P. Hellman
Research and Statistics Division, Selective Service System

The statistical program of the Selective Service System furnishes the data necessary to the planning and operation of its task of procuring manpower for the armed forces with the least possible disturbance to the Nation's economic and social life. This statistical work is essential in the three primary processes of Selective Service: (1) registration and classification in general, (2) occupational deferment, and (3) physical examination.[1]

The medical statistics part of the program is concerned entirely with the results of physical examinations and is based almost wholly on the reports of the physical examinations of registrants.[2] The medical data obtained are used (1) to supply states and local boards with the most current information concerning physical examinations and (2) to provide a basis for estimating the effects on manpower procurement of different levels of physical standards.

The initial emphasis of the medical statistics program was on research. At that time the main interest of Selective Service was in the rehabilitation of men rejected for military service and in forecasting the effect of the high physical standards in use during peace on the future war-time procurement of millions of registrants for the armed forces. The statistical needs of the System could best be served by a thorough understanding of the characteristics of the men physically examined for military service. An exhaustive study was therefore made of the information on the registrants' physical examination reports, and, although this research phase was just getting under way when the United States entered the war, the experience gained from it was invaluable when the work later became focused on administrative or program statistics.

THE RESEARCH PHASE

During 1940 and 1941 each registrant considered for induction was given a complete physical examination[3] by the local board physician

[1] See McGill, K. H., "The Statistical Program of the Selective Service System," this Journal, March 1944, Vol. 39, pp. 10–20.

[2] Broad aspects of the medical statistics program were outlined by Folk, O. H., "Selective Service's Medical Statistics Program," this Journal, December 1942, Vol. 37, pp. 425–429.

[3] Registrants with obvious defects, such as those with both arms or legs missing or those who were determined to be educationally deficient, were not always given a complete physical examination but Forms 200 were usually filled out for these registrants.

who recorded his findings on a Selective Service form entitled "Report of Physical Examination" and numbered DSS Form 200. If the registrant was found physically fit and subsequently given another complete examination at the induction station, the results were recorded on a War Department form designated as WD, AGO Form 221 which was entitled "Report of Induction of Selective Service Man."

The medical sections of both reporting forms were identical. In general, the left hand portion of the page provided separate lines for recording defects or diseases of specific parts of the body. Space was also provided for summarizing the registrant's defects in order of importance. The right hand portion was devoted to recording results of special tests and measurements.

Provisions were made for National Headquarters to receive from the local boards a copy of the Form 200 for every registrant physically examined. A copy of WD, AGO Form 221 for men rejected after induction station examination was received by the local boards and in turn transmitted to National Headquarters. The Selective Service System did not receive copies of WD, AGO Form 221 for inducted registrants during the period in which this form was in use.[4]

In consequence, the research phase of the medical statistics program centered around the processing of Form 200. Since approximately 84 per cent of the registrants forwarded by local boards for induction station examination were inducted, a fairly complete picture of the defects of Selective Service registrants examined during this period was available from Form 200. A brief outline of the way in which the report was prepared by the local boards will serve to indicate the type of data recorded.

Filling out Form 200.—When a registrant was notified to appear for local board examination, the local board clerk affixed the local board stamp with code on the form and entered the identifying and general information concerning the registrant (name, address, order number, race, birthdate, birthplace, mother tongue, occupation, and whether the registrant's residence was urban or rural). At the time the registrant presented himself for examination, he was entitled to make a statement of any defects he believed he had and was required to answer specific questions concerning his past medical history. These were recorded on the report and the registrant was required to sign his name to the statement certifying that the information was correct.

The local board physician then examined the registrant in accordance with the Selective Service regulations. Negative as well as positive

[4] In 1943, the Surgeon General's Office of the War Department, which did receive copies of WD, AGO Form 221 for inducted registrants, forwarded these forms to National Headquarters.

findings were recorded on Form 200 as the examination progressed. In addition, measurements such as teeth counts, visual and auditory acuity, pulse and blood pressure readings, and height and weight were entered. Blood and urine specimens were taken for the serological blood test for syphilis and urinalysis, respectively. A chest x-ray was usually taken if tuberculosis was suspected. In cases of unusual diagnostic difficulty or when the registrant appealed his classification as a result of physical examination, a partial or complete examination was also given by a specialist on the Medical Advisory Board and these findings were likewise recorded.

After the physical examination, the physician summarized the defects in order of importance and entered his recommendation concerning the registrant's availability for military service. In cases where he believed the registrant was not qualified for general military service, he recorded the defect or defects on which he based his decision. The local board considered the physician's recommendation and in most cases concurred, classified the registrant accordingly, and entered the class on the report.

The Forms 200 were transmitted to National Headquarters along with a transmittal sheet which listed the names and order numbers of the registrants whose reports were forwarded. These transmittal sheets, sent in duplicate, were checked against the forms received and one receipted copy ultimately returned to the local board. The statistical processing of the Forms 200 was begun at National Headquarters late in 1941.

Pilot study.—As a preliminary to processing the Forms 200 on a large scale, a set of codes, including a detailed one on medical defects, was developed. These codes were tested on 30,000 cases representing one and one-half per cent of the reports received through May 31, 1941. From this pilot study the adequacy of the codes and the relative informational value of the items on the schedule were determined. The results of this study were presented in Medical Statistics Bulletin No. 1, which was released by the Selective Service System in November 1941.[5]

Ten per cent sample study.—It was decided that the larger study on the defects of examined registrants should also be conducted on a sample basis. Forms 200 for all of the 6,441 local boards were to be included. Two problems were immediately apparent: (1) the time period to be covered and (2) the size of the sample.

From November 1940 through September 1941, the physical ex-

[5] See also Rowntree, L. G., McGill, K. H., and Folk, O. H., "Health of Selective Service Registrants," *Journal American Medical Association*, April 4, 1942, Vol. 118, pp. 1223–1227.

amination procedure followed by local boards in each state was uniform. From October 1, 1941, to the end of the year the procedure was in a state of change. Since the Forms 200 for registrants examined through September 30, 1941, had the advantage of being homogeneous with respect to physical examination procedure, it was decided that they should be used for the study. Accordingly, two files were set up—one for examinations made through September 30, 1941, and one for those made subsequent to that date. The reports were filed by state, county, and local board; and within each local board these reports were filed by the order numbers which had been assigned to the registrants as a result of the national lotteries of October 29, 1940, and July 17, 1941, on the first and second registrations respectively.

Reports from local boards indicated that Form 200 had been filled out for approximately 3,000,000 registrants during the period November 1940 through September 1941. Facilities were available for processing about 300,000 forms, which would represent a 10 per cent sample of these examinations, and would provide adequate medical data for the individual states. However, not all the physical examination forms had been transmitted to National Headquarters and the sampling ratio which had to be applied in order to obtain a 10 per cent sample varied from one local board to another. A count of the number of forms transmitted by each local board was therefore made.[6] After it had been determined that the number of Forms 200 received was at least 85 per cent of the number of forms prepared in each state, the sample for each local board was obtained by applying the following formula:

$$\frac{P}{10} = \sum F_i R_i \qquad i = 1, 2, 3.$$

where P = the number of forms reported to have been filled out by the local board

F_i = the number of forms transmitted to National Headquarters by the local board

R_i = sampling ratio

and $F_{i+1} = F_i(1 - R_i)$.

Thus, if the first sampling ratio were $\frac{1}{9}$, every ninth form was drawn from the file. For most local boards, two sampling ratios were sufficient to obtain the desired sample. No more than three sampling ratios had to be computed for any local board.

[6] As a preliminary step in counting the Forms 200, duplicate copies and copies representing more than one examination of the same registrant were stapled together and counted as one form. Also forms for registrants rejected for moral or administrative reasons (prison record, dishonorable discharge from the Army, Navy, etc.) were discarded if no physical examination had been made.

Processing the forms.—In processing the forms for the 10 per cent sample, coding boxes were overprinted on the left hand margin of the form. Specific instructions on how to code the various items were prepared. As different coding problems arose supplements were issued. The items coded fell roughly into four groups: (1) general information, (2) results of special tests, (3) results of special measurements, and (4) medical defects.

Coding general information.—The items included in this group were: local board number, order number, race, occupation, size of city, birthplace, birthdate, month last seen by physician, date of examination, physician's recommended classification, and the action taken by the local board. Some of these items were precoded; for example, the local board stamp which appeared on each form included a code of 8 digits—2 for the state, 3 for the county and 3 for the local board number. This was a standard code used for processing other Selective Service documents.

Manuals and indexes were prepared for coding occupation, size of city and birthplace. In order to set up the occupational index, it was necessary to analyze entries on the 30,000 forms of the pilot study to see what degree of detail should be utilized and what entries should be listed. A two-digit code convertible to those in use by other government agencies was adopted and an alphabetical index and a numerical index were developed for this code.

Coding the results of special tests.—The results of chest x-ray, serologic tests for syphilis, and urinalysis were coded for each registrant. The difficulties encountered in coding chest x-ray were mainly concerned with determining whether a chest x-ray had been taken, since these x-rays were not taken routinely for all examined registrants. On most forms, however, there was some statement as to whether the registrant had any lung pathology. A list of entries was therefore drawn up and the coder was instructed as to which of these indicated x-ray findings.

Similar difficulties were raised in interpreting results of urinalysis. In addition, many cases showed that more than one serologic blood test for syphilis had been made and a table had to be established indicating the correct code when the results of these tests were different.

Coding the results of special measurements.—These items included measurements of vision, hearing, pulse, blood pressure, girth, height, weight, and teeth counts. Height, weight and girth offered no problems in coding.

Hearing and vision measurements were recorded in a variety of ways and detailed instructions as to the interpretation of the measurements had to be developed. For instance, hearing measurements were recorded

sometimes in descriptive terms such as "hears nothing," "partially deaf." In other cases results of tests other than those prescribed in regulations were entered and these results had to be converted into terms of standard tests. Similar difficulties arose in the coding of vision measurements.

Pulse and blood pressure coding offered different problems. An analysis of pulse reading showed that almost all were divisible by 2 or 4. This indicated that many physicians took the number of pulse beats in 15 seconds or 30 seconds and multiplied by 2 or 4 to get the number per minute. Blood pressure readings were almost all divisible by two. Consequently, instead of coding each pulse or blood pressure reading, the code set up represented a grouping of two consecutive numbers. Thus a pulse or blood pressure reading of 100 or 101 was coded 31, 102 or 103 was coded 32.

The examining physician or dentist recorded the dental count on a chart which was part of the form. Different symbols were used to record the condition of specific teeth. Thus if a tooth (represented by a number) was encircled it meant that the tooth was carious. In many instances the tooth chart was not filled out or the findings were written below the chart. Methods had to be worked out for standardized coding. As in the case of vision and hearing measurements, qualitative entries had to be translated into quantitative terms.

Setting up the medical defect code.—The Army regulations (Mobilization Regulations 1–9), which prescribe standards for men entering the military service, determined to a large extent the broad outline of the medical code. Also, since the items referring to the physical examination on the Form 200 followed the subdivisions of the Army physical standards it was expedient to adopt these groupings. The skeleton of the code consisted of 27 broad defect groups representing the various parts of the body and certain specific diseases or defect entities as shown in Table I.

No specific terminology was prescribed in the physical standards for recording the registrant's defects on the physical examination form. Although many physicians adhered to the language of the MR 1–9 they were free to describe defects in any language they chose and as a result there was wide variation in the nomenclature used. This was to be expected since the defect entries represented the findings of approximately 28,000 examining physicians and 10,000 examining dentists in the 6,441 local boards.

In setting up the rubrics two types of problems arose: (1) What detail should be carried under each of the broad groups? (2) How should the titles be worded and what defects should they include?

TABLE I

CODES FOR THE 27 BROAD DEFECT GROUPS USED IN PROCESSING FORMS 200

Defect group	Code	Defect group	Code
Eyes	001–049	Syphilis	440–459
Ears	050–079	Venereal diseases other than syphilis	460–479
Teeth	080–109	Skin	480–529
Mouth and gums	110–129	Hemorrhoids and other rectal defects	530–559
Nose	130–149	Varicose veins	560–579
Throat	150–169	Mental deficiency and mental disease	580–639
Lungs	170–209	Neurological	640–669
Tuberculosis	210–229	Musculoskeletal	670–809
Cardiovascular	230–299	Feet	810–829
Blood and blood-forming	300–319	Endocrine disturbance	830–859
Hernia	320–349	Cancers, tumors	860–899
Kidney and urinary system	350–379	Infectious, parasitic and epidemic diseases	900–919
Abdominal viscera	380–399	Other diseases, defects and anomalies	920–999
Genitalia	400–439		

An analysis of the entries made on the 30,000 forms of the pilot study indicated that the defects were recorded in sufficient detail insofar as the end result of the pathologic process was concerned but not with respect to the cause of the defect. For example, underweight was often recorded as a defect by the physician without mentioning whether this condition was due to malnutrition or endocrine dyscrasia. It was therefore impracticable to adopt any nomenclature which was as detailed as that used in hospitals and in research institutions. Thus, the decision was made to include rubrics which described the end-result rather than the etiology, although in some specific cases, such as defects resulting from syphilis, the etiology was given preference.

Since the program was set up largely for research purposes it was advisable to carry as much detailed information as was available for certain defects. For example, hernia was subdivided into such titles as direct inguinal, indirect inguinal, abdominal, etc. However, it was not feasible to carry refined diagnoses such as a specialist would record since this information would not be available in the majority of cases.

Conferences with members of the Medical Division in National Headquarters and with leading specialists in medicine and medical statistics were held to discuss how the titles should be worded and what defects they should include. The titles adopted were not limited to exact medical terminology but were based largely on the entries made by the physicians on the 30,000 forms used in the pilot study. With few exceptions, a code was established only when the frequency of the entry warranted it. Thus, a title was reserved for "one leg shorter than other" because of the frequency with which this entry was made.

The greatest difficulty was encountered in setting up the codes for mental disease. This was due to the variety of classifications in the field. The entries on the forms were extremely varied and not too concise with the result that the codes set up for mental disease were relatively less specific than for other groups.

In those cases where confusion in coding was anticipated, definitions were established describing what types of defects should be included in the rubric. The major problems of overlapping codes were thus settled in advance of the actual coding operation.

A medical code of 515 rubrics was adopted. Blocks of three-digit numbers were assigned to each of the 27 broad defect groups shown in Table I. The first two digits specified the broad defect group; for example, the numbers 05–07 were assigned to ear defects. The third digit designated specific diseases, defects, or locations of the disease or defect. Thus, 050 was assigned to descriptions of bilateral deafness, 051 to unilateral deafness, 052 to defective hearing, etc. In most instances the last rubric in each broad defect group was reserved for defects not elsewhere classifiable in the group, as 079 for "other ear defects." Certain code numbers were left blank in each block to cover expansion should this become necessary.

Medical defect coding.—In order to maintain uniformity in the coding of medical entries, extensive manuals had to be developed. Precise medical terminology was not a problem in setting up these manuals. The problems arose in connection with the many entries on the forms which were couched in idiomatic expressions or lay language and in the fact that many entries were symptoms instead of diagnoses.

The coding manual for defects was based on the medical entries which had been copied from the 30,000 forms referred to above. One of the manuals listed in alphabetic order the key words and permissible modifiers along with the code number; the other manual, numerical in arrangement, listed permissible entries under each rubric. Key words consisted of standard diagnostic terms, parts of the body, or the cause of a disease or defect. The modifier expressed cause, degree of disability, or stage to which the condition had progressed. Permissible modifiers were often enclosed in parentheses; instructions to the coders were enclosed in brackets.

Entries in the alphabetical index followed essentially four patterns:

(1) Disease or defect entities not likely to have modifiers, such as:

273 Buerger's disease

(2) Diseases or defects likely to have a few common modifiers, such as:

355 Pyelitis (acute, chronic) (low grade, mild, moderate, severe)

Note: The code number 355 could be assigned to "pyelitis" or to pyelitis with any combination of the modifiers in the parentheses.

(3) Diseases or defects likely to have many permissible modifiers such as:

013 Trachoma (including following locations)

bilateral	left eye	O. S.
both eyes	O. D.	right eye

(including following descriptive terms)

active	chronic conjunctivitis	old
acute	history of	scars
chronic	incipient	scars from ulcer
chronic blepharitis	mild	slight scarring of conjunctiva

Note: The code number 013 could be assigned to "trachoma" with or without any combination of the locations and descriptive terms.

(4) Diseases or defects the degree of which determined the code number to be applied, such as:

Pes planus [if no descriptive term is given code 829] .

[When followed by one and only one of the following descriptive terms, code in accordance with the list below]

821 a little	829 pain(ful) (on standing)
829 asymptomatic	822 partially
823 bad(ly)	821 plus one
823 complete(ly)	822 plus two
823 definite(ly)	823 pronounced
823 eversion (with)	
821 plus one	823 with pronation

Setting up indexes in accordance with these patterns eliminated repetitious terms and therefore had the advantages of saving space and providing greater readability. It also had the advantage of giving the coders a broader understanding of the content of the various medical rubrics.

Coders were instructed (1) to read each medical entry on the form

in its entirety, (2) to select the key word in each entry which referred to a part of the body or to a disease, and (3) to look up each key word in the alphabetic index. If the coder could match, word-for-word, the entry on the form with terms listed in the index, the indicated code number could be assigned. Forms thus coded were given to another coder who verified the code number assigned by using the numerical index. It should be noted that this procedure was particularly verbalistic and that coders were not obliged to know the meaning of the entries that were coded. Supervisors had access to text books on medicine and the medical dictionary which aided greatly when problems arose in the coding of particular defect entries. Entries which the supervisor could not code even with these aids were usually referred to the physicians in the Medical Division of National Headquarters. The entries which were difficult to code were recorded on cards and a file of these maintained for reference and possible revision of the index. In some cases the registrant's own statement of his physical condition which was recorded on the form served to help in coding the registrant's defects. This was also true in those cases where statements from hospitals or sanitoriums had been stapled to the form by the local board clerk.

A code number was assigned for each defect on the form but only selected codes were copied in the superimposed coding boxes reserved for defects. The code for the registrant's principal defect was entered in the first of these boxes. The principal defect of a registrant found qualified for general military service was the first defect listed on the form by the physician in his summary of defects. For a registrant found not qualified for general military service, the principal defect was the first defect entered in the local board classification section, the physician's certification section, or in his summary of defects.

Selection of the final code numbers for defects followed three general principles:

(1) Certain codes referred to medical defects which could be listed both in words and in measurements. Code numbers for these word entries were followed by an "X" (as "004X"—partial blindness), to indicate to the coder that the code number (without the "X") was to be selected as a final code only (a) in those cases where the defect was recorded as the principal defect and (b) in those cases where the defect was secondary and the measurements were not given.

(2) When the physician entered a vague description of a defect or a non-specific description such as "kidney trouble" in his summary of defects or in the certification section, and a more specific description such as "chronic nephritis" appeared above in the space for recording

kidney defects, the code number for chronic nephritis was used instead of the code number reserved for unspecified kidney defects.

(3) Often, information entered in one part of the form was duplicated elsewhere in different words and it became necessary to set up safeguards against coding the same condition two or more times for a registrant. Therefore, a procedure was established whereby only one defect was coded for each broad defect group. For instance, if a registrant with rheumatic heart disease was also recorded as having a mitral systolic murmur, cardiac hypertrophy, and dyspnea on exertion, only rheumatic heart disease was coded, since all these conditions are part of the rheumatic heart disease picture. At the time the medical defect codes were developed, all of the defect titles in each broad defect group of this code were ranked in order of preference and listed on a priority chart for the use of the coders. Diagnostic terms headed the list, followed by less serious conditions and less inclusive terms. Thus, in any broad defect group, only the term which was most descriptive of the registrant's condition was finally coded. Under this procedure a registrant could have as many defects coded as there were broad defect categories.

Punch card.—After the defect codes had been selected, entered in the superimposed coding boxes and verified, they were transferred to punch cards. Chart I is a facsimile of the punch card used. A separate card was punched for each selected defect. Thus if a registrant had three defects he would have three punch cards. The first card, called the master card, contained the registrant's principal defect. All other cards were called trailer cards and had the same information as the master card with the exception that each carried a secondary defect.

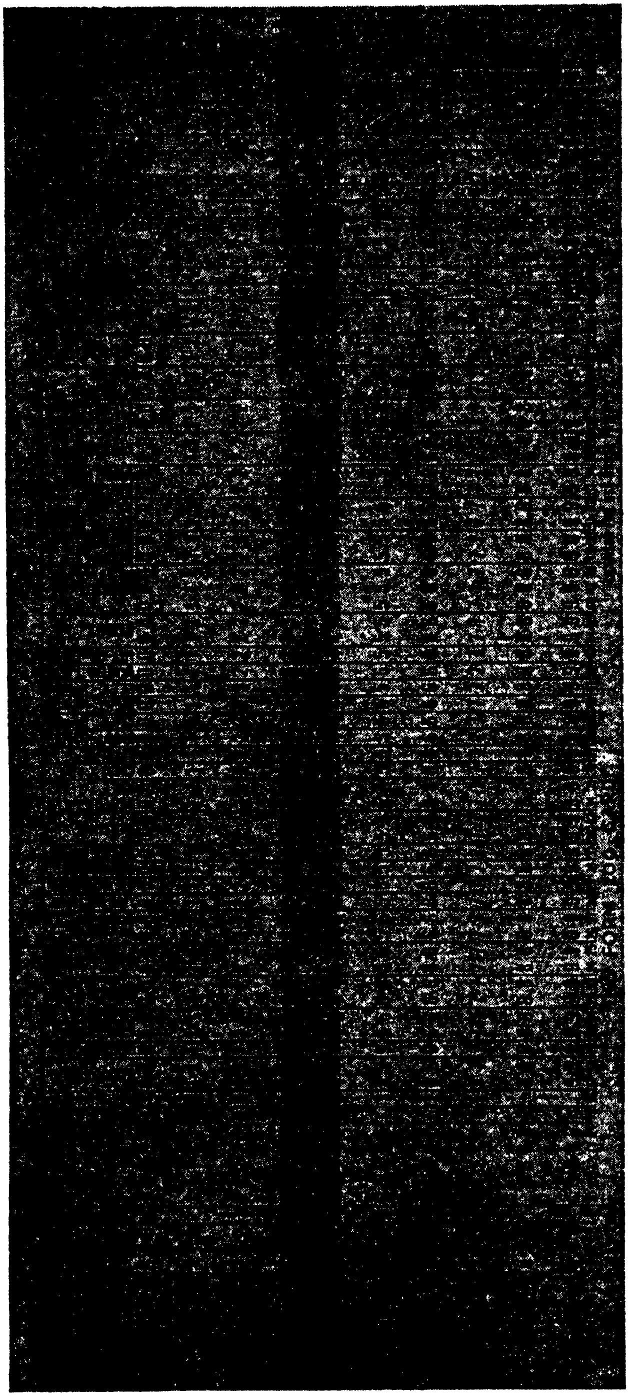
The advantage in having one card for each defect was that it facilitated counting all recorded defects, whether principal or secondary. It also made possible a detailed study of registrants with certain types of defects. The disadvantage was that it made difficult the study of the association of defects in any one registrant except by a complicated tabulating procedure.

Results.—The punch cards have been tabulated to secure information by race, on the defects of registrants in relation to local board classification, occupation, city size, and data on the results of special tests and measurements. The following is a partial list of the tables prepared:

(1) Principal defect and all defects in relation to local board classification and age,
(2) Occupation in relation to local board classification and principal defect.

CHART I

PUNCH CARD USED IN PROCESSING THE 10 PER CENT SAMPLE OF DSS FORM 200



(3) All recorded defects by city size and local board classification,
(4) Height by weight by local board classification,
(5) Vision measurements in relation to eye defects,
(6) Teeth counts in relation to hearing measurements,
(7) Pulse rate in relation to blood pressure readings.

These tabulations have been the basis for Medical Bulletin No. 2 in which the data presented are mainly concerned with the defects of examined registrants. They will also be used in connection with other Medical Bulletins on the results of special tests and measurements. The information has likewise been applied for purposes of estimating (1) the number of registrants with remediable defects, (2) the number of registrants who would be available for service in the armed forces if registrants with limited service defects were inducted, and (3) the probable effects of changes in physical standards on the procurement of military manpower.

THE ADMINISTRATIVE PHASE

With the entry of this country into the war, the complete physical examination of a registrant at the local board was replaced by a routine physical inspection. Under the revised regulations, a registrant could be disqualified for military service after this inspection by the local board physician only if he had a manifestly disqualifying defect. A list of such defects, 141 in number, was made available to each local board physician as a guide.

If the registrant passed his local board examination and was subsequently forwarded to the induction station, he was given a complete physical examination by specialists there. The use of DSS Form 200 and WD, AGO Form 221 was discontinued and in its place a single form was introduced—DSS Form 221, Report of Physical Examination and Induction. The new form provides space for the results of both the local board inspection and the induction station examination.

Filling out DSS Form 221.—When the registrant is notified to appear for local board examination, the local board clerk fills out the first page of the form, consisting of (1) identifying information such as the registrant's name, local board, order number, address, birthdate; and race; and (2) socio-economic data—his education, marital and dependency status, and occupation and employment status—which are obtained from the registrant's classification questionnaire, DSS Form 40, or from later information in the registrant's folder, DSS Form 53, when it is available.

The DSS Form 221 is sent to the local board physician, whose examination includes drawing a specimen of blood from the registrant

for a serological test for syphilis and entering remarks concerning his general impression of the registrant's physical fitness. If the registrant has a manifestly disqualifying defect, this defect is also recorded by the physician. The local board then classifies the registrant and the clerk enters his classification on the DSS Form 221.

If the registrant is forwarded to the induction station he is given a complete physical examination there which includes special tests and measurements. The section provided in the DSS Form 221 for the recording of induction station findings is almost identical with the physical examination section of DSS Form 200, including the summary of the registrant's defects in the order of their importance.

After the registrant is examined by the specialists at the induction station, the chief medical examiner reviews all the findings and specifies for what type of service the registrant is qualified. If the registrant is not qualified for general service the defects upon which the decision is based are specified. The action taken at the induction station, whether the registrant is rejected or inducted, is also entered on the form. The final section of the DSS Form 221 is devoted to the local board's reclassification of the registrant after his induction station examination.

DSS Form 221 is filled out in quadruplicate and one copy of the form is transmitted by the local board through State Headquarters to National Headquarters for all registrants physically examined, whether rejected at the local board or examined at the induction station. The transmittal sheet is similar to that which was used for forwarding DSS Form 200 to National Headquarters.

Several advantages accrue from the use of one form for both local board and induction station examinations: (1) it provides National Headquarters with a complete record of the physical examinations and classifications of both inducted and rejected registrants; (2) it makes it easier for the induction station examiners to review the results of the local board physical examination; (3) it simplifies local board and National Headquarters' files, since only one form is required for each registrant; and (4) it makes relatively detailed data available on the socio-economic status of the registrant in relation to the outcome of the physical examination, which was not the case with DSS Form 200 or WD, AGO Form 221.

Processing the forms.—For the operational and planning purposes of the entire Selective Service program it is necessary to process the DSS Form 221 statistically with a view to making periodic reports to the states and local boards on their own physically examined registrants. In order that the reports to the states be representative of the registrants

examined and also as current as possible, local boards must transmit the National Headquarters' copy of DSS Form 221 promptly. Weekly receipt records are therefore kept on the number of these forms transmitted by each state and a cumulative monthly "completeness of reporting" index is computed. This index consists of the ratio of the number of DSS Forms 221 received to the total number of men reported as having been examined from the time the form was first used to the end of the current month. States with low indexes of receipt are notified to that effect. Thus, the forms transmitted each month represent some examinations made in previous months. In the statistical processing of the forms they are handled by month of receipt and not by month of examination.

During the first three months in which DSS Form 221 was used, all the forms received were processed in a manner similar to that for DSS Form 200, that is, the detailed medical code was used, and most of the socio-economic data and also the results of special tests and measurements were coded. However, this procedure did not produce enough processed forms to serve administrative needs for medical data, because of the large number of items coded and the detailed medical code used. The decision was therefore made to code only those socio-economic terms important for administrative purposes, to eliminate the coding of special tests and measurements and to abridge the medical defect code.

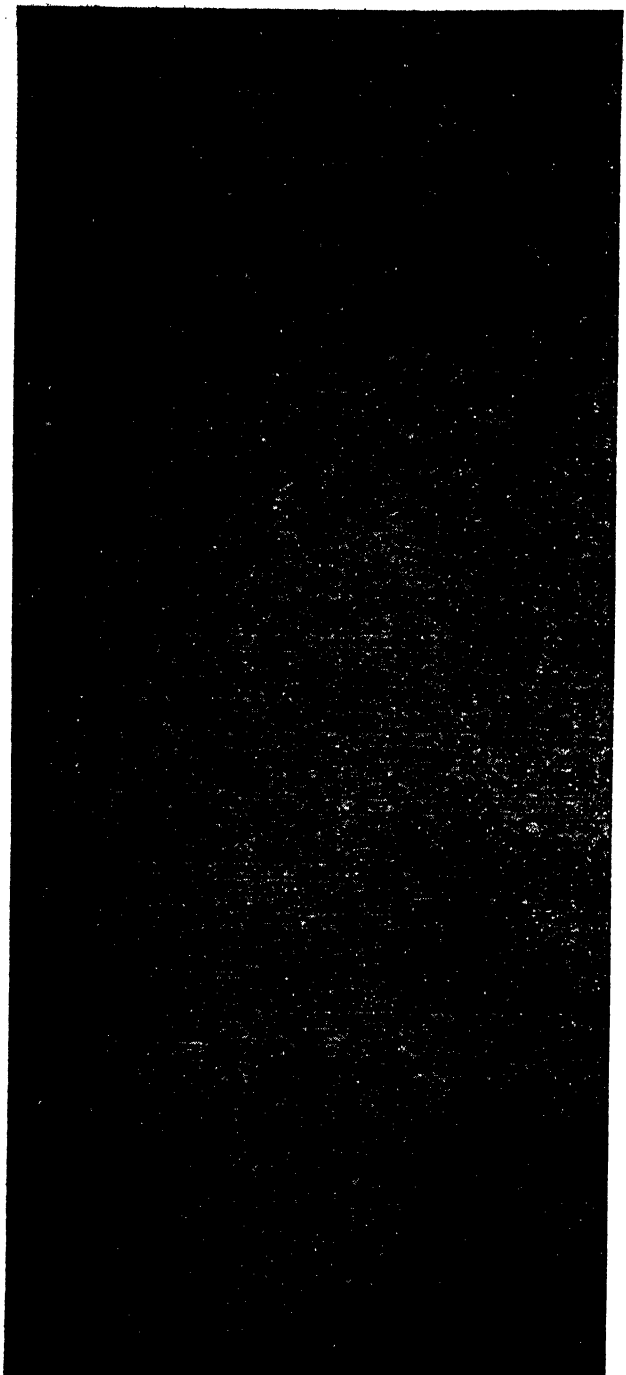
In view of the increasing numbers of registrants examined each month and the resulting increase in the number of DSS Forms 221 received, it was also decided that only a 25 per cent sample of the forms would be coded. Accordingly, as each shipment of forms is received, every fourth form is withdrawn for processing.

In processing the forms it has been found that from three to five per cent of the sample are reports for registrants who have passed the local board physical examination but are not sent to the induction station because they are deferred for occupational or dependency reasons after the local board examination. Inasmuch as the purpose of processing the DSS Forms 221 is to obtain data on the defects of inducted or rejected registrants, and also since only a screening examination is given at the local board, the DSS Forms 221 for these registrants are not processed.

Coding.—The identifying and socio-economic data which are coded include: registrant's local board, order number, race, birthdate, marital and dependency status, occupation and employment class, number of examination, result of examination and date of examination. Most of these items are coded in much the same way as they were on DSS Form

CHART II

PUNCH CARD USED IN PROCESSING THE 25 PER CENT SAMPLE OF DSS FORM 221



200. The only medical data other than the registrant's defects which are coded are the results of serologic blood tests for syphilis.

In order further to speed up processing, a defect code of only 100 rubrics is used. This code was drawn up in such a way that the 515-rubric medical defect code which was used in processing Forms 200 is readily convertible to it. Only rubrics which had large frequencies, as revealed in the processing of Form 200, and those which were of administrative interest were retained. The code numbers of this abridged code were so arranged that the first two digits specify the broad defect group. Thus 00 represents eye defects, 01 ear defects, 02 teeth defects, etc. The third digit specifies the defect; thus, for endocrine defects, 241 denotes diabetes mellitus, 242 Fröhlich's syndrome, etc. Certain numbers were left open for possible expansion of the code. As in processing the Forms 200 the rule has been continued to code only one defect in each broad defect group. To facilitate this choice, the code numbers in each broad defect group were arranged in decreasing order of preference, i.e., the more serious defect for coding purposes was the one with the lower code number. Word-for-word coding was discontinued and consequently the indexes set up for the abridged code do not contain as many entries as those for the 515-rubric code.

The coding of medical defects on DSS Form 221 differs from that on DSS Forms 200 in that only those defects listed in the "physician's summary" are coded. Defects listed in the separate items are referred to and coded only when they are more specific than the defect described in the summary. Thus if a physician recorded "Eye trouble" in the summary of defects and the entry in the space provided for recording eye defects was "chronic conjunctivitis" the more specific entry is coded. The principal defect, however, is selected in much the same manner as on the DSS Form 200.

Punch card.—The DSS Form 221 has printed code boxes on its left-hand margin which bear numbers corresponding to the items of the form, to facilitate coding entries. As in the case of DSS Form 200, the number of cards punched for each registrant depends on the number of defects coded. The master card contains the principal defect; the trailer cards have the secondary defects.

Results.—The master cards have been used to prepare (1) special reports for administrative purposes within National Headquarters and (2) periodic tabulations for the various states and local boards. Both types of information cover the principal defects of inducted and rejected registrants. In addition, master and trailer cards have been tabulated in combination to furnish data on the prevalence and the association of defects. During the period April 1942 through Septem-

ber 1943, approximately 1,800,000 DSS Forms 221 were processed and more than 2,400,000 cards prepared.[7] Examples of the more important tabulations, all of them specific for race, are:

(1) Principal defects of rejected registrants in relation to age and occupation,
(2) Principal defects of registrants rejected at local boards, and rejected or inducted at induction stations,
(3) Occupations of examined and inducted registrants,
(4) Marital and dependency status of examined and inducted registrants,
(5) Age of examined registrants in relation to Selective Service classification,
(6) All recorded defects of examined registrants in relation to Selective Service classification,
(7) Association of defects among rejected registrants.

These tabulations form the basis for furnishing to National Headquarters (1) current reports on the defects of examined registrants; (2) estimates on the defects of registrants not yet examined; and (3) monthly estimates of defects of registrants in Class IV-F. The latter estimates have been widely applied because of the increasing need for salvaging, as physical standards have changed, all Class IV-F registrants who could qualify for service in the armed forces.

The more significant of all this information on the wartime physical examination experience of Selective Service registrants is presented in confidential state releases. The data are also incorporated in Medical Statistics Bulletin No. 3 and in a monograph on the medical aspects of the Selective Service System which is being prepared for later release.[8]

From this report on the methods used, it is apparent that, in planning for the processing of the physical examination reports, changes in regulations and revisions in physical standards were anticipated. In addition, the medical and socio-economic codes which were used were based on actual entries on the physical examination reports rather than on any standard codes then existing. All this has resulted in a flexible medical statistics program for Selective Service which could be adapted to the changing needs of the System by building on the fundamental codes and procedures of the first, or pilot, study.

[7] Since November 1943, the Forms 221 have been forwarded to the National Headquarters of the Selective Service System through the Surgeon General's Office of the War Department which processes a sample of these forms. Duplicate copies of the punch cards are furnished to the Selective Service System for tabulating purposes. In general, the processing methods now being used by the Surgeon General's Office are adaptations of those described herein for Forms 200 and 221 and were adopted by a joint committee of the War and Navy Departments and the Selective Service System.

[8] See also Rowntree, L. G., McGill, K. H., and Edwards, T. I., "Causes of Rejection and Incidence of Defects Among 18 and 19 year old Selective Service Registrants," *Journal American Medical Association*, September 25, 1943, Vol. 123, pp. 181–185.

BENEFITS AND BENEFICIARIES UNDER SOCIAL INSURANCE AND RELATED PROGRAMS

By Franklin M. Aaronson
Social Security Board

The enactment of the Social Security Act in 1935, and the subsequent amendments in 1939, marked a major change in the approach to the problems of economic insecurity in this country. Previous to this legislation, which established a national social insurance system as a means of meeting the problems of loss of income resulting from old age, death, or unemployment, relief programs of various types were the main support of those who had suffered loss of income and resources.

With the enactment of the Social Security Act, social insurance became for millions of families the first line of defense against economic insecurity, while relief programs became supplementary in character. Table I gives some idea of the relative importance of these two types of programs in total income payments for 1942 and 1943.

TABLE I
INCOME PAYMENTS TO INDIVIDUALS, 1942 AND 1943*
(In billions)

	1943	1942
Total income payments†	$142.2	$116.6
Compensation of employees	100.7	79.7
Entrepreneurial income net rents and royalties	27.7	23.9
Dividends and interest	10.1	9.4
Relief	1.0	1.7
Social insurance and related programs‡	1.7	1.8
Military allowances	1.0	.1

* Source—U. S. Department of Commerce 1943 preliminary.
† Includes Veterans' bonus payments; less than $50 million in each year.
‡ For programs included see Table II.

In 1942, for the first time, payments under social insurance and related programs exceeded payments under relief programs, even though payments under the Social Security Act had by 1942 attained only a small proportion of their potential volume. While the effect of full employment has probably had a somewhat more drastic effect on relief payments than on total social insurance and related payments, it is doubtful whether relief payments will again exceed payments made under social insurance and related programs, unless there is a serious and prolonged depression during the immediate post-war period.

However, the shift in the method of meeting the problems of economic insecurity is not as yet complete—large segments of the popula-

tion are not included under the Social Security program nor are several important risks included in the provisions of the Act. Thus self-employment, domestic service, employment in agriculture, nonprofit organizations, Federal, state, and local government, and some miscellaneous groups, are specifically excluded from the Act, while the risks of disability and injury are not included as insurable risks.

In administering the Social Security Act the Board has a responsibility for studying and making recommendations as to the most effective methods of providing social security protection. Such a responsibility involves an analysis of all Federal, state, and local programs which make use of social insurance techniques to offset income loss. For several years, as part of the over-all program directed toward this objective, the Board has been developing an integrated series of statistical data on the number of beneficiaries under programs using social insurance techniques and the amount of payments to these recipients.

Such a series provides an answer to two related questions of interest to the Board in the formulation of plans for strengthening social security protection. These questions, which naturally follow from the limitations of the present Act are:

1. How many individuals excluded under the Social Security Act are covered by related programs and what is the extent and character of protection under such programs?
2. How many systems which provide insurance against risks not included in the Act are in operation and what is the extent of protection under such systems?

Combining data for these systems with data relating to programs operating under the Social Security Act, it is possible to obtain some measure of the over-all protection afforded by social insurance and related programs.

The following pages discuss some of the problems involved in this project and present quantitative measures of the extent of social insurance protection in this country today. It is thought that the presentation of these data in the JOURNAL will make available to statisticians, in general, information which has been known to a somewhat more limited group of persons working in the field of social security.

In the integrated social insurance statistics series a social insurance program has been defined as "a public program making payments to covered workers or their dependents on the basis of previous employment or service records, according to formulas specified in the laws, with payments financed from contributions of employers, employers and employees, or from public funds." After considering various alternatives the series has been entitled "social insurance and related programs" to make allowance for the systems which meet the test of a social insurance system as defined but have additional attributes as

well, such as governmental retirement systems which not only provide protection against economic insecurity but form an important part of personnel policy.

The definition excludes from the series systems operating under private auspices and relief programs under which payments are based on need, rather than on employment or service records. Included under the definition are all public systems making retirement, disability, or survivor payments or payments for periods of unemployment. The systems thus included, together with the groups covered, are as follows.

Program	*Covered groups in 1942*
Old-Age and Survivors Insurance	Approximately 46 million industrial and commercial workers
Railroad Retirement	Approximately 2 million railroad workers
Federal Civil Service Retirement	Approximately 3 million Federal Government employees
Other Federal Contributory Retirement	Employees of TVA, Comptroller General's office, Foreign Service of State Department, Federal Reserve Board, civilian employees of Naval Academy—approximately 25,000
Federal Noncontributory Retirement	Members of regular military establishment, Public Health, Coast and Geodetic Survey, Federal Judiciary—no estimate of number covered is available
State and Local Government Retirement	About half of all state and local government employees—approximately 1.7 million covered.
Veterans' Pensions	About 10 million members of armed forces of World War II, plus beneficiary veterans and survivors of veterans of previous wars
Workmen's Compensation	No estimate of number covered is available
State Unemployment Compensation	Approximately 41 million industrial and commercial workers
Railroad Unemployment Insurance	Approximately 2 million railroad workers

It should be noted that considerable duplication in the number of workers occurs in this table. Thus, of the 45 million workers who earned some taxable wages under the OASI system in 1942, approximately 41 million were also covered by the state unemployment compensation programs and a considerable number by the state workmen's compensation laws. Other duplications are possible during the course of a year or over a longer period as workers shift from one type of covered employment or service to another type.

While there will be no attempt to analyze the provisions of these

systems in this article it should be noted that the protection afforded by the different systems varies considerably—thus some employees enjoy retirement, disability and survivor protection while workers covered by other systems have protection against only one or two of these contingencies; again there is considerable variation in the benefit provisions among programs insuring the same risk under different state laws.[1]

The relative importance of social insurance and related payments in the total flow of income payments provides a basis for evaluating the effectiveness of these programs in meeting the problem of income loss. It also affords an opportunity for judging the interrelationships between social insurance and relief payments and the various other types of payments. In order to provide a basis for this type of analysis, the Social Security Board has made use of the income payment series of the Department of Commerce which includes data on social insurance and relief payment furnished by the Board (see Table I). In order to make the Commerce series, as published, more nearly conform to Social Security Board needs, certain adjustments are made in the Commerce data, as shown in the following tabular summary.

INCOME PAYMENTS TO INDIVIDUALS

As published by the Department of Commerce	*As published by the Social Security Board*
Total*	Total*
Wages and salaries	Compensation of employees*
Total	Wages and salaries
Work relief	Other labor income
Direct and other relief	Relief
	Work
	Direct and other relief
Social security benefits and other labor income (incl. military allowances)	Social insurance and related payments
Dividends and interest	Dividends and interest*
Entrepreneurial income, net rents and royalties	Entrepreneurial income, net rents and royalties*
Veterans' bonus	Veterans' bonus
	Military allowances

* Adjusted for seasonal variation.

[1] See articles in the following issues of the *Social Security Bulletin:*
March 1940—"Social Insurance Payments in the United States"
April 1941—"Benefits and Beneficiaries Under the Civil Service Retirement Act"
January 1942—"Workmen's Compensation Benefits in the United States, 1939 and 1940"
January 1942—"Federal Contributory Retirement Systems Other Than Civil Service"
November 1942—"Pensions and Compensation to Veterans and Their Dependents"
July 1943—"State and Local Employees Covered by Government Retirement Systems"

It will be noted that in the Commerce series work relief is included in wages and salaries; and other labor income, which includes allowances to members of the armed forces, industrial pensions, and directors' fees, is included with social security benefits. In the Social Security Board's adjusted series, work relief is subtracted from wages and salaries and included under relief, while other labor income is separated from social security benefits and other labor income and added to wages and salaries to get compensation of employees. These shifts in classification provide, for Social Security Board purposes, a clearer distinction between social security and other income payments. Data are available in the Board on both a seasonally adjusted and unadjusted basis; only the seasonally adjusted data are published in the *Social Security Bulletin* each month.

BENEFIT PAYMENT DATA

Tables II and III present the latest information available concerning payments made under the various social insurance and related programs in this country. Table II presents annual data and contains

TABLE II

SOCIAL INSURANCE AND RELATED PAYMENTS TO INDIVIDUALS IN THE UNITED STATES, 1942 AND 1943

(Amounts in millions)

Type of payment	1943	1942
Total	$1,703	$1,844
Retirement, disability, and survivor	1,622	1,494
Old-age and survivor insurance	173	137
Railroad retirement	133	129
Federal retirement	162	150
Civil service	91	81
Other Federal contributory*	1	1
Federal noncontributory†	70	68
State and local government‡	325	309
Veterans' pensions	452	441
Workmen's compensation	377	328
Unemployment insurance	81	350
State unemployment insurance	80	344
Railroad unemployment insurance	1	6

* Includes retirement systems for employees of TVA, Federal Reserve Board, Office of Comptroller General, Foreign Service of State Department, and civilian employees of Naval Academy.

† Includes retirement systems for members of regular military establishment, Public Health Service, Coast and Geodetic Service, and Federal Judiciary.

‡ Estimates of Department of Commerce. Exceed SSB estimates by approximately $100–$150 million due to inclusion of payments made by systems making service-connected disability payments only (analogous to workmen's compensation payments); payments made under private endowment plans; payments made under plans providing for purchase of annuities through private insurance companies. Commerce estimates, included here in order to be consistent with figures in Table I, will be revised in line with recent SSB estimates.

statistics on some programs not included in Table III where data are on a monthly basis. For the programs omitted from the monthly series—workmen's compensation, state and local government retirement systems, and Federal contributory and noncontributory retirement systems other than the Civil Service Retirement system—no monthly reported data are available on a Nation-wide basis. As explained in more detail later, the Social Security Board has made annual estimates for the first two of these programs, and for the other programs data on an annual basis are available from published sources. The data presented in Table III are obtained from the agencies responsible for the administration of the programs and are used by these agencies for administrative purposes. While the change in payments from month to month under all except the unemployment insurance programs is slight, the data are compiled and presented on a monthly basis for several reasons. First, one important use of the data is in connection with monthly income payment estimates; second, for several programs the agency reports are on a fiscal year basis and they are here made available by months for adjustment on either a calendar or fiscal year basis; third, the wide variations in unemployment insurance payments cause the total to change considerably from month to month thus necessitating a monthly series for uses where the current situation is of importance; fourth, there is a steady upward trend in retirement disability and survivor statistics which is of interest to persons working in the field of social security.

The figures for all programs represent payments to individuals and exclude the cost of administering the programs. While it would have been desirable to have all payment data on a disbursement basis, variations in the accounting procedures of the various agencies made this impossible. Thus payments under the various programs are represented by amounts certified to the Secretary of the Treasury, and by checks issued, as well as by actual disbursement data. Insofar as possible, figures are on a net basis; that is, adjustments have been made for cancellations, voided checks, and for underpayment and recoveries of overpayments.

These data have been developed in cooperation with the various agencies administering the programs, or in the case of certain programs not under one agency, by means of estimation from available data. For each program in Table II, except the workmen's compensation and state and local government retirement systems, it was possible to obtain the payment figures from a central agency. The problem in such instances was to secure from these different agencies, data which would

be on a comparable basis. Inasmuch as the benefit and beneficiary data are obtained under the direction of different agencies, and are in most cases a by-product of the administrative process, they naturally differ in certain respects. An examination of the footnotes to the tables will indicate the necessary qualifications to be used in the interpretation of the figures.

For several programs there is no central agency which administers the program; the administration is in the hands of many agencies scattered throughout the states. Thus the state unemployment compensation and workmen's compensation programs operate under state laws and state and local retirement systems operate under state laws and local ordinances. For the state unemployment compensation figures the Social Security Board obtains reports from each of the states and thus is able to compile information on a national basis. Inasmuch as there is no central collecting agency for the other two programs it has been necessary to make a complete survey of available statistics for these programs in order to build up the data to a national level. A brief discussion of the methods used in preparing estimates for these programs is presented here, inasmuch as for these programs the statistics were not developed in cooperation with any one agency but represent essentially the work and responsibility of the Social Security Board.

Estimates of workmen's compensation benefit payments.—Reports of state workmen's compensation were first examined as a possible source of workmen's compensation benefit statistics. It was found that while such reports provide data in far greater detail and variety than any other source, lack of comparability in the statistical data prevented their use as a basis for national aggregates or for comparable state data.

The most nearly complete and comparable statistics on the national volume of workmen's compensation benefits paid each year are to be found in: *Spectator, Premiums and Losses by States*, published annually by the Chilton Company. The *Spectator* data are compiled from the annual statements that casualty insurance companies must file with the various state insurance departments. The figures designated "net losses" represent the amount of cash and medical benefits paid on workmen's compensation insurance policies during a calendar year. The total for the United States so reported is incomplete principally by the amounts paid by self-insurers and by certain state funds, chiefly those not required to file annual statements.

The *Spectator* data were, therefore, used as the basis for annual estimates of total workmen's compensation benefit payments. To the

TABLE

SELECTED SOCIAL INSURANCE AND RELATED PROGRAMS:

(Corrected to

Year and month	Total	Retirement, disability, and						
		Total	Monthly retirement and disability payments†				Monthly	
			Social Security Act‡	Railroad Retirement Act§	Civil Service Commission¶	Veterans' Administration**	Social Security Act††	Railroad Retirement Act§
	Amount (in thousands)							
Calendar year:								
1936	$461,760	$458,765	—	$683	$51,630	$299,001	—	$2
1937	505,143	499,532	—	40,001	53,694	299,660	—	444
1938	972,926	575,814	—	96,766	56,118	301,277	—	1,383
1939	1,046,006	608,095	—	107,282	58,331	307,512	—	1,451
1940	1,191,908	654,042	$21,075	114,166	62,019	317,851	$7,784	1,448
1941	1,090,104	726,631	55,141	119,913	64,933	320,561	25,454	1,559
1942	1,137,073	780,364	80,304	122,806	68,115	325,265	41,702	1,603
1943	929,415	838,046	97,257	125,795	72,961	331,350	57,763	1,704
1942								
December	79,566	67,333	7,338	10,402	5,858	27,493	4,082	137
1943								
January	80,392	67,307	7,464	10,302	5,913	27,310	4,171	135
February	79,209	67,763	7,623	10,364	5,941	27,293	4,308	138
March	80,534	68,778	7,781	10,386	5,968	27,416	4,492	140
April	77,486	69,230	7,871	10,444	5,985	27,410	4,615	140
May	76,797	69,454	7,976	10,386	6,022	27,449	4,735	139
June	75,849	69,288	8,004	10,432	6,067	27,456	4,770	143
July	76,114	69,702	8,193	10,447	6,087	27,820	4,824	143
August	75,630	69,511	8,262	10,565	6,095	27,307	4,912	148
September	76,497	70,475	8,358	10,602	6,180	27,393	5,056	142
October	75,924	71,376	8,471	10,609	6,195	27,716	5,174	146
November	76,408	71,912	8,566	10,615	6,228	28,204	5,284	142
December	79,019	73,250	8,686	10,643	6,280	28,574	5,422	148

* Data represent payments to individuals and exclude cost of administration. Payments under Social Security and Railroad Retirement Acts (including retroactive payments) and payments under Railroad Unemployment Insurance Act are amounts certified; payments under Civil Service Commission and Veterans' Administration are disbursements minus cancellations; State unemployment insurance payments are checks issued by state agencies. Totals are sums of unrounded figures, therefore may differ slightly from sums of rounded figures.

† Old-age retirement benefits under all acts, disability retirement benefits under Railroad Retirement and Civil Service Retirement Acts, and disability payments to veterans.

‡ Represents primary and wife's benefits and benefits to children of primary beneficiaries. Partly estimated.

§ Amounts certified, minus cancellations. Monthly payments to survivors include annuities to widows under joint and survivor elections and 12-month death-benefit annuities to widows and next of kin.

¶ Represents principally payments from civil-service retirement and disability fund but includes also payments from Canal Zone retirement and disability fund and Alaska Railroad retirement and disability fund administered by Civil Service Commission. Monthly retirement payments include accrued annuities to date of death paid to survivors. Data for calendar years 1936–39 estimated on basis of fiscal-year data.

III

PAYMENTS TO INDIVIDUALS, BY SPECIFIED PERIOD, 1936–43*

April 4, 1944)

survivor payments					Refunds to employees leaving Federal civil service¶	Unemployment insurance payments		
Survivor payments								
	Lump-sum							
Veterans' Adminis-tration‡‡	Social Security Act§§	Railroad Retire-ment Act§	Civil Service Com-mission¶	Veterans' Adminis-tration¶¶		Total	State unem-ployment compen-sation laws***	Railroad Unem-ployment Insurance Act†††
Amount (in thousands)								
$99,992	—	—	$4,062	$3,395	$2,864	$131	$131	—
96,370	$1,278	—	4,401	3,684	3,479	2,132	2,132	—
101,492	10,478	$291	4,604	3,405	3,326	393,786	393,786	—
109,192	13,896	1,926	4,952	3,553	2,846	435,065	429,298	$5,767
105,696	11,736	2,497	5,810	3,960	3,277	534,589	518,700	15,889
111,799	13,328	3,421	6,170	4,352	4,615	358,858	344,321	14,537
111,193	15,034	4,114	6,108	4,120	6,357	350,352	344,084	6,268
116,133	17,830	5,560	7,344	4,350	10,809	80,560	79,643	917
9,432	1,362	413	489	327	521	11,712	11,558	155
9,423	1,395	313	538	343	701	12,384	12,182	202
9,332	1,453	421	547	342	408	11,038	10,878	160
9,445	1,672	414	627	435	870	10,887	10,744	142
9,530	1,635	517	668	417	781	7,475	7,369	106
9,549	1,665	565	601	367	907	6,437	6,383	54
9,480	1,398	513	629	395	571	5,990	5,950	41
9,309	1,418	517	578	367	817	5,594	5,564	31
9,427	1,416	470	565	342	886	5,234	5,191	43
9,845	1,434	483	644	339	1,544	4,477	4,433	44
10,200	1,433	465	625	341	957	3,591	3,546	44
10,244	1,442	437	419	329	915	3,582	3,540	42
10,349	1,468	445	902	‡‡‡333	1,453	4,316	4,274	42

** Veterans' pensions and compensation payments.

†† Represents widow's, widow's current, parent's, and child's benefits. Partly estimated.

‡‡ Payments to widows, parents, and children of deceased veterans.

§§ Represents survivor payments with respect to deaths of covered workers under both the 1935 and 1939 acts, and, for the period January 1937–August 1939, payments to covered workers at age 65 totaling $9.9 million, which are not survivor payments.

¶¶ Payments for burial of deceased veterans.

*** Annual figures adjusted for voided benefit checks; monthly figures unadjusted.

††† 1941, 1942, and 1943 annual figures adjusted for underpayments and recoveries of overpayments; monthly figures unadjusted.

‡‡‡ Preliminary estimate.

Source: *Social Security Bulletin.*

amounts of "insurance losses paid" as reported in the *Spectator* were added the amounts paid by exclusive state funds and by those competitive state funds not included by *Spectator*. These data were obtained from published reports of the state workmen's compensation agencies or from unpublished data furnished by the agency. An estimate was then made of the amount of benefits paid in each state by self-insurers. The basis for these estimates was primarily data in the state reports and unpublished data supplied by state agencies in response to special requests.

Using these sources it was possible to build up an estimate of benefit payments under workmen's compensation laws on an annual basis. It was not possible from these sources, however, to obtain a basis for estimating payments on a monthly basis[2] nor to estimate the number of beneficiaries receiving payments. Work on this project is still under way and it is hoped that it will be possible to make such estimates in the future.

Estimates of benefit payments under state and local government retirement systems.—The problem of obtaining data relating to operations of these systems was similar to that for workmen's compensation but in some respects more difficult. This was due to the fact that not only do systems operate under state laws but also under many city and local ordinances. After reviewing the availability of reports from these systems, it was found that the smaller systems did not publish reports and while most of the larger systems did publish statistics on an annual basis, the lack of comparability between the reports and the absence of certain details made it necessary to seek other sources of information. It was decided, therefore, to ask the cooperation of the Division of State and Local Government of the Bureau of the Census in a mail canvass survey of the systems in operation. From the returns of this canvass, the Division of State and Local Government of the Census and the Division of Coordination Studies of the Board developed national estimates of benefit payments and beneficiaries for the fiscal year 1940–41. Using this over-all survey as a basis, it was possible to make estimates for other years from published reports and Census data.

The schedule used in the mail canvass contained items which permitted estimates to be made for total annual benefit payments, payments and beneficiaries in the last month of the fiscal year; it also covered employment and wages, and a few other items.[3] Thus for pur-

[2] The annual estimate made by the Social Security Board is used by the Department of Commerce in developing their income payment series. Monthly estimates based on this annual figure are made by the Department of Commerce by means of straight-line projections.

[3] See Bureau Report No. 12: *Scope of Protection Under State and Local Government Retirement Systems.*

poses of the integrated series, estimates for annual benefit payments are available but not payments for each month. Further work on this project will probably make it possible to estimate, by months, payments and number of beneficiaries receiving such payments. The Department of Commerce plans to substitute the annual estimates on benefit payments as derived from this survey for the figures it now carries in its income payment series. On the basis of this annual estimate it will make estimates of monthly payments.

For two other types of systems—Federal contributory and noncontributory retirement systems—data are available on an annual basis from the individual agencies. Monthly figures are not available[4] in reported form and these programs are therefore not included in Table III.

Table II presents total payments by program, while for the programs for which monthly data are available, as shown in Table III, payments are distributed into monthly and lump-sum payments under the different programs. A further breakdown of the data on an annual basis shows the following distribution of payments according to the type of risk for 1942, the latest date for which estimates are available.

Total*	$1,560 (million)
Retirement†	439
Disability	517
Survivor	254
Unemployment	350

* Differs from total in Table II because of omission of payments for medical care under workmen's compensation and due to use of the Board's estimates for state and local retirement systems instead of Commerce estimates. Approximately $33 million in refunds to employees leaving Government service are also excluded.

† Includes small amount of disability or survivor payments under Federal contributory or noncontributory systems other than Civil Service retirement system.

Distribution of annual payments under the old-age and survivors insurance program, the railroad retirement and unemployment insurance programs, the state workmen's compensation program, the workmen's compensation and veterans' program are also available by state.

Number of beneficiaries.—The number of beneficiaries receiving the benefit payments, shown in the monthly series on payments, has also been compiled for each program with the cooperation of the responsible agency (Table IV). The term beneficiary as used in connection with this series means a person entitled, on the basis of an insured worker's employment record, to a payment on account of old age, disability, unemployment, or death of the insured worker. Under the old-age and

[4] Estimates of monthly payments based on the annual figures are made by the Department of Commerce for inclusion in their income payment series.

TABLE IV

SELECTED SOCIAL INSURANCE AND RELATED PROGRAMS: INDIVIDUALS RECEIVING PAYMENTS, BY MONTHS, 1943

(In thousands; data corrected to April 4, 1944)

Month	Retirement, disability, and survivor beneficiaries											Employees receiving refunds upon leaving Federal civil service§§	Unemployment insurance beneficiaries	
	Monthly retirement and disability beneficiaries				Survivor beneficiaries									
					Monthly			Lump-sum‡‡						
	Social Security Act*	Railroad Retirement Act†	Civil Service Commission‡	Veterans' Administration§	Social Security Act¶	Railroad Retirement Act**	Veterans' Administration††	Social Security Act	Railroad Retirement Act	Civil Service Commission	Veterans' Administration		State unemployment compensation laws¶¶	Railroad Unemployment Insurance Act***
January	385.4	154.9	72.8	622.8	262.3	3.8	311.5	9.8	1.0	0.7	3.7	10.0	226.8	4.0
February	364.6	155.4	73.4	622.0	269.7	3.9	311.2	10.2	1.3	.7	3.7	9.3	208.6	3.5
March	369.9	155.4	73.7	621.0	279.2	3.9	311.9	11.9	1.2	.8	4.4	14.8	181.5	2.6
April	375.1	155.6	74.0	620.8	288.2	3.9	312.2	11.8	1.4	1.0	4.1	13.1	131.2	1.9
May	380.6	155.6	74.4	621.9	297.2	3.9	313.4	11.9	1.6	.9	3.8	13.0	119.5	1.0
June	383.9	156.0	74.8	623.0	302.9	4.0	314.8	10.0	1.4	.9	3.8	12.2	100.3	.7
July	390.7	156.3	74.7	624.8	307.0	4.0	313.1	10.2	1.4	.9	3.7	20.9	90.6	.5
August	393.9	157.1	75.1	627.0	312.4	4.1	313.9	10.2	1.3	.8	3.2	22.3	88.8	.7
September	397.3	157.7	75.5	629.1	321.5	4.1	315.6	10.2	1.3	1.0	3.5	27.5	74.5	.7
October	401.3	158.1	76.0	633.7	329.5	4.1	318.4	10.1	1.2	1.3	3.4	17.3	60.7	.7
November	405.9	158.6	76.6	640.1	336.9	4.1	320.5	10.2	1.2	.8	3.4	18.4	56.4	.7
December	411.4	159.0	76.8	648.6	344.6	4.1	322.7	10.5	1.2	1.4	3.3	25.6	64.4	.7

* Primary beneficiaries and their wives and children for whom benefits were certified.

† Annuitants and pensioners on roll as of 20th of month; includes disability annuitants.

‡ See Table III, footnote 5. Includes persons receiving survivor benefits under joint and survivor elections. Figures not adjusted for suspension of annuities of persons reemployed under National Defense Acts of June 28, 1940, and Jan. 24, 1942.

§ Veterans receiving pensions and compensations.

¶ Widows, parents, and children for whom benefits were certified.

** Widows receiving survivor benefits under joint and survivor elections and next of kin receiving death-benefit annuities for 12 months; number on roll as of 20th of month. Widows receiving both survivor and death-benefit annuities are counted twice, but 2 or more individuals sharing 1 death-benefit annuity are counted as 1.

†† Widows, parents, and children of deceased veterans on whose account payments were made during month.

‡‡ For Social Security Act, deceased wage earners whose survivors received payments under either the 1935 or 1939 act; for Railroad Retirement Act, deceased wage earners whose survivors received payments certified in month ended on 20th calendar day; for Civil Service Commission, employees who died before retirement age and annuitants with unexpended balances whose survivors received payments; for Veterans' Administration, survivors or other persons entitled to reimbursement for expenditures in connection with burial of deceased veterans.

§§ See Table III, footnote 5 for programs covered.

¶¶ Represents average weekly number of benefit recipients.

*** Represents average number of persons receiving benefits for unemployment in a 14-day registration period.

Source: *Social Security Bulletin.*

survivor program, several beneficiaries can be entitled to a monthly retirement benefit on the basis of one worker's wage record; thus if at time of retirement, the wife of the insured worker is also 65 or over she is entitled to a benefit equal to one-half of the worker's benefit as are all children under 16 or aged 16–18 if in school, subject to the limitation that the total benefit shall not exceed twice the primary benefit.

For the other programs making monthly retirement or disability payments as shown in the Table the benefit is made to the insured person only and is not increased for dependents. In the case of monthly payments to survivors both the OASI and veterans' programs make payments to widows and children on the basis of one employment or service record and each entitled member of the family is recorded as a beneficiary. Under the railroad retirement and civil service programs monthly survivors benefits are paid only to survivors of annuitants who have elected a reduced annuity during their own lifetime, and there is ordinarily only one beneficiary for an insured worker. Under the unemployment insurance programs the beneficiaries represent only the unemployed workers inasmuch as benefits are not adjusted for the number of dependents.[5]

It should be noted that the number of beneficiaries under the different programs should not be totalled in order to obtain the number of individuals receiving benefits inasmuch as the same beneficiary may be receiving payments under two different programs. No estimates have yet been made as to the extent of this duplication. It should be noted also that the number of different individuals receiving weekly unemployment benefits during a month will be larger than the average weekly number of beneficiaries shown in Table IV or than the number in any one week during the month.

In some cases the number of beneficiaries represents the number who were certified for payment during the month, in other cases the number on the rolls as of a certain day of the month, and for the unemployment insurance programs the average number receiving payments in a period during the month. While the unit of count varies thus among the programs, the data are on as comparable a basis as is possible. Except as concepts necessarily differ for weekly and monthly benefits, differences are not of such magnitude as to affect to any serious degree comparability of the data.

The number of beneficiaries receiving payments under the state and local government retirement systems is available only for the last

[5] Except in the District of Columbia where the beneficiaries reported represent workers only.

month of each fiscal year; for the workmen's compensation program and the Federal retirement program, other than under the Civil-service retirement system, no data on the number of beneficiaries are available.

The classification of beneficiaries follows that for payments, and the total number of beneficiaries under each program can be obtained as well as the number receiving the same type of payment under different programs.

Estimates of the number of families receiving monthly benefit payments based on the beneficiary data are also available. From OASI beneficiary tabulations on family size, it is possible to reduce the number of persons receiving benefits under this program to a family basis. The number of beneficiaries receiving monthly retirement or disability payments under the railroad retirement and civil-service retirement programs represents approximately the number of families receiving benefits since these programs do not provide supplemental benefits for wives and children of retired workers. Statistics are available from the Veterans' Administration which give the number of families receiving monthly survivor payments while the number receiving monthly compensation payments represents the number of veterans only and therefore represents a like number of families. Beneficiaries of unemployment compensation payment also represent the number of family units except insofar as there may be occasional families with more than one unemployed member drawing benefits. For December 1943 the number of families represented by the 756,000 monthly beneficiaries under the OASI program is estimated at 472,000; under the railroad and civil-service retirement programs the number of families receiving monthly payments was approximately 239,900; the 971,300 monthly beneficiaries of the Veterans' Administration represented about 892,800 families.

From the data presented in the foregoing tables it is possible to obtain a measure of the number of individuals receiving payments under social insurance and related programs and the amount of such payments. While such information is valuable to students of social and economic problems, it is, of course, subject to several limitations in evaluating the extent of social insurance protection. Such factors as differing benefit levels, eligibility requirements, coverage provisions and other items provide useful and necessary criteria in any measurement of social security protection. However, the over-all data on payments and beneficiaries form a basic part of the total picture necessary in an evaluation of social security needs in the country.

USE OF THE SURVIVAL RATE METHOD IN MEASURING NET MIGRATION*

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The use of the survival rate method for measuring net migration during intercensal periods has been developed in the United States by Hart (1), Baker (2), Hamilton (3) and (4), Lively and Taeuber (8) and Lorimer (7).

Although the method is quite simple and has been widely used, some further refinements and applications have been made since the publication of the United States census for 1940. Therefore, the purposes of this paper are:

1. To demonstrate that in measuring net migration during recent intercensal periods survival rates derived from the age distributions of the federal census are superior to survival rates derived from life tables.
2. To show how survival rates based on state and national life tables may be used in adjusting federal census survival rates for use on a state basis.
3. To demonstrate two reliable methods of deriving survival rates for use in measuring net migration on a county basis.
4. To draw attention to the method of measuring the rate of net migration and of calculating the amount of migration among people who die during an intercensal period.
5. To explain a method for measuring the relation between net migration and population pressure.

SUPERIORITY OF CENSUS SURVIVAL RATES FOR CERTAIN PURPOSES

A survival rate is the complement of a mortality rate. If the mortality rate is .012, then the survival rate is .988. Survival rates for most purposes may be calculated from the L_x column of a life table showing the "stationary population in year of age X to $X+1$."

The life table survival rate is simply the ratio of the stationary population in a given age interval to the population in a lower (younger) age interval. The rate thus calculated expresses the proportion of the

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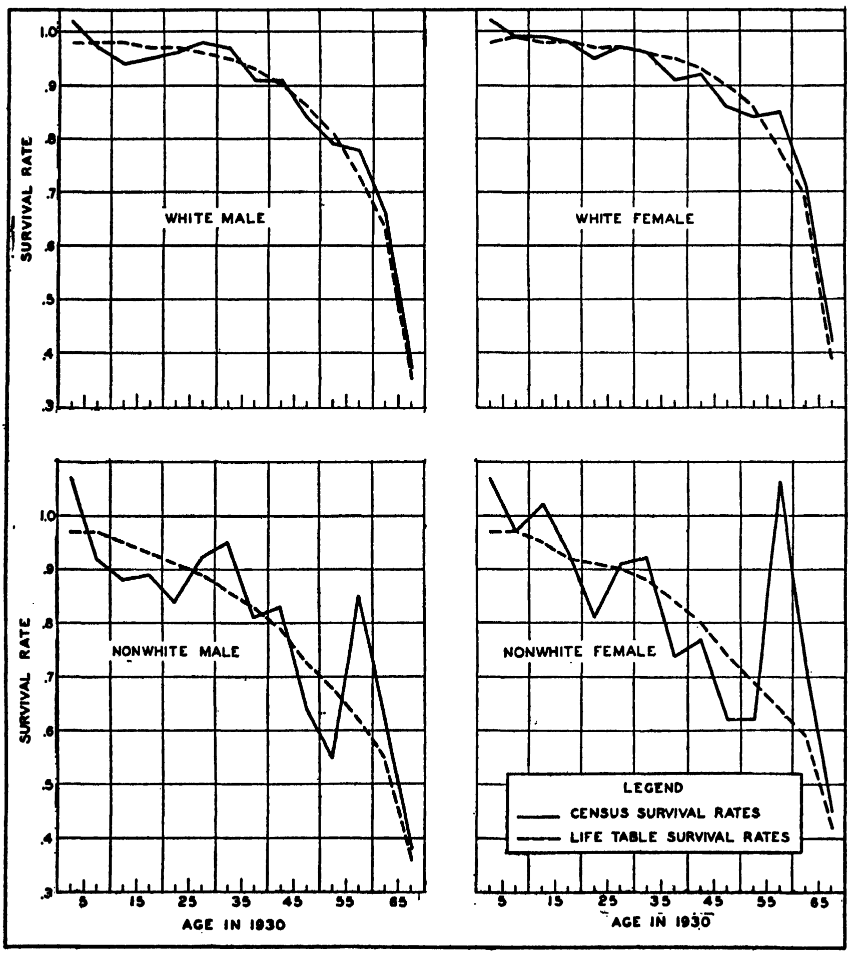
lower age group which will probably survive until the higher age level is reached.

The advantage of using a life table is that rates for any age group and for any time interval may be easily calculated. Thus, life table survival rates have been used in measuring net migration from farms during the periods 1930–35 and 1935–40 (8). Life table survival rates also have many other uses.

Census survival rates are calculated directly from the age distribution tables of the United States censuses, on the assumption that migra-

CHART I

SURVIVAL RATES BY SEX AND COLOR COMPARING CENSUS AND LIFE TABLE SOURCES



tion to or from the United States has been negligible during the period involved.

A census survival rate, for a ten-year period, is simply the ratio of

TABLE I

SURVIVAL RATES BY AGE, SEX AND COLOR, 1930-1940, FOR POPULATION OF THE UNITED STATES AS CALCULATED FROM LIFE TABLES AND FROM CENSUS*

Age groups 1930	1940	White male LTR†	CR†	White female LTR	CR	Nonwhite male LTR	CR	Nonwhite female LTR	CR
0–4	10–14	.975	1.019	.980	1.021	.968	1.069	.972	1.068
5–9	15–19	.984	.973	.988	.990	.970	.923	.970	.969
10–14	20–24	.979	.944	.984	.989	.951	.884	.945	1.017
15–19	25–29	.963	.952	.977	.979	.928	.892	.923	.934
20–24	30–34	.978	.963	.973	.952	.906	.841	.910	.806
25–29	35–39	.961	.983	.968	.971	.886	.916	.896	.912
30–34	40–44	.950	.970	.960	.962	.863	.951	.875	.920
35–39	45–49	.931	.909	.948	.910	.829	.806	.844	.747
40–44	50–54	.903	.914	.929	.923	.785	.826	.801	.766
45–49	55–59	.862	.838	.900	.863	.730	.641	.743	.619
50–54	60–64	.805	.787	.855	.836	.675	.558	.685	.624
55–59	65–69	.728	.775	.788	.847	.619	.853	.638	1.059
60–64	70–74	.625	.657	.690	.717	.547	.618	.586	.721
65–up	75–up	.355	.372	.393	.422	.364	.380	.415	.450

* The Life Tables used in these calculations were constructed by the authors using Metropolitan Life Insurance Company data as well as United States Vital Statistics Reports.

† LTR indicates *life table* rates, and CR indicates *Census* rates.

TABLE II

RATES OF NET MIGRATION FROM FARMS OF THE UNITED STATES DURING DECADE 1930–40 BY AGE, SEX AND COLOR, AS CALCULATED BY LIFE TABLE RATES (LTR) AND CENSUS RATES (CR)*

Age Groups†	White male LTR	CR	White female LTR	CR	Nonwhite male LTR	CR	Nonwhite female LTR	CR
5–9	1.4	1.9	− 2.2	− 1.4	− 1.8	− 6.7	− 6.7	−10.8
10–14	− 3.5	− 2.4	−12.8	−12.9	−15.7	−11.4	−18.1	−18.1
15–19	−25.6	−22.8	−36.7	−37.1	−32.6	−27.5	−31.2	−36.1
20–24	−36.9	−35.5	−35.8	−36.0	−42.0	−39.7	−41.4	−42.0
25–29	−23.0	−22.6	−14.6	−13.0	−31.7	−26.4	−36.9	−28.8
30–34	1.0	1.0	3.6	3.2	− 4.9	− 8.0	−10.3	−11.9
35–39	7.7	5.4	2.6	2.4	7.6	− 2.4	− 2.7	− 7.5
40–44	4.7	7.2	− 3.0	1.1	0.3	3.2	−17.2	− 6.4
45–49	8.2	6.8	− 2.0	− 1.4	16.9	11.0	−10.6	− 6.5
50–54	3.6	6.5	− 7.1	− 3.1	− 7.8	5.1	−26.0	−11.1
55–59	.8	3.2	− 9.4	− 7.4	−21.7	− 5.4	−19.2	−11.3
60–64	8.2	1.6	− 4.3	−11.0	30.7	−15.9	42.0	−14.5
65–69	1.7	− 3.2	−10.1	−13.4	−11.6	−12.8	4.2	−15.2
70–over	− 2.8	− 7.3	− 2.7	− 9.4	− 8.4	−12.3	− 1.3	− 8.9

* Life Tables used in these calculations were constructed by the authors, using Metrpolitan Life Insurance Company data and U. S. Census Vital Statistics Reports. The CR rates relate to total population and not to farm population.

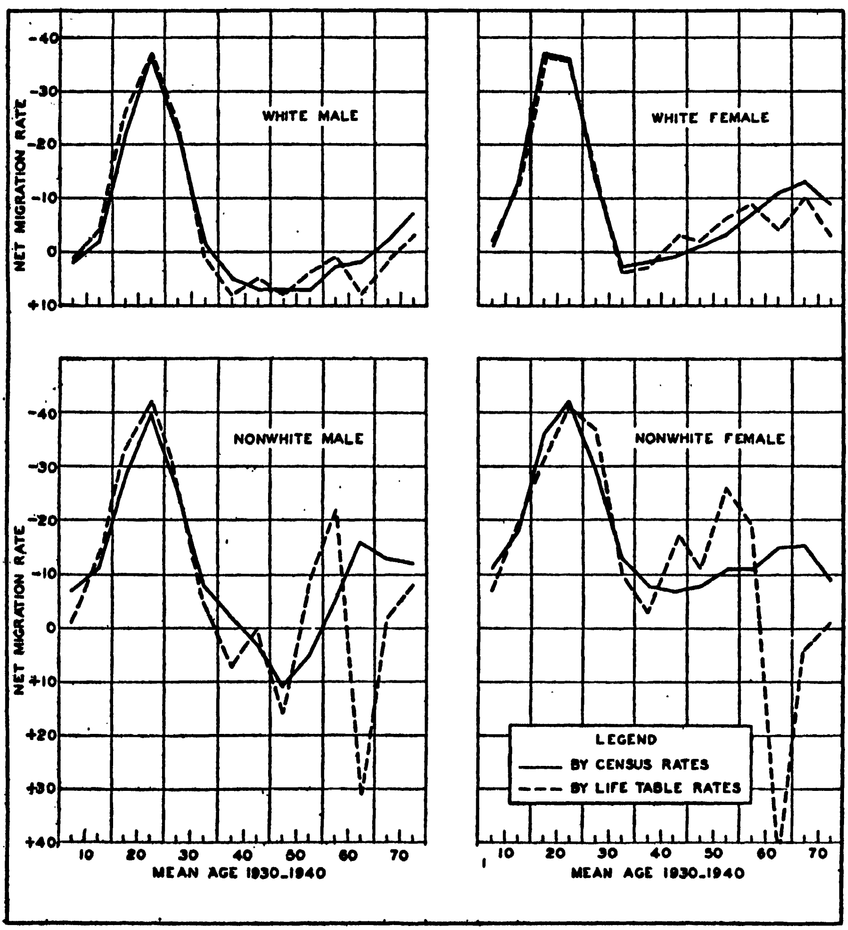
† As of middle of decade. Midpoints used on charts.

population of a given age at the end of the period to the population ten years younger at the beginning of the period. A twenty year survival rate might also be calculated but migration is rarely a negligible factor over such a long period. Obviously, census survival rates are more restricted in usefulness than life table survival rates.

However, census survival rates have one distinct advantage, that is, *they serve not only as survival rates but also as correction factors for errors in reporting ages to the census.* This point has been treated elsewhere, (3) and (4). Further confirmation is given in this paper. Chart I and Table I show a comparison between *life table* and *census* survival rates.

CHART II

NET MIGRATION RATES BY SEX AND COLOR, COMPARING RESULTS OBTAINED BY APPLYING CENSUS AND LIFE TABLE RATES



The assumption is that the age curve of net migration should be a relatively smooth one. But as shown in Chart II based on Table II, the age curve of net migration from the farms of the United States between 1930 and 1940 is quite irregular when compared with the corresponding curve based on census rates. If the assumption is granted (and it is certainly reasonable), these data are proof of the superiority of census rates.

In calculating census survival rates for the decade 1920–30, the age distributions of native white and of Negro population, by sex, should be used in order to eliminate the bias due to net migration to America of approximately 3,000,000 people during that time (12).

Some error, however, enters in, because an unknown number of foreign born whites, so reported in 1920, report themselves as native whites in 1930. This tends to make the census survival rates for native whites somewhat too high (4, p. 62). This error is probably not as great as it might be were the census survival rates based upon the total population. A migration of approximately 3,000,000 net to the United States between 1920 and 1930, was enough to cause considerable bias in census survival rates based upon total population.

Net migration to or from the United States between 1930 and 1940 was relatively small—being only 47,000 out movement (13). Therefore, during this period, the bias in census survival rates, based upon total population is much less than it would be if they were based upon the native born population. Henderson (14, pp. 41–42) estimates that over 100,000 persons classified as foreign born white in 1930 were classified as native white in 1940.

ADJUSTING SURVIVAL RATES FOR REGIONAL MORTALITY DIFFERENCES

Census survival rates calculated on a national basis may and should be adjusted for mortality differences in the various states or regions for which estimates of survivors and migration are to be made. Life tables and life table survival rates for the Nation and for the states and regions serve as a basis for calculating the necessary correction or adjustment factors.[1]

The correction factors are simply the differences between the life table survival rates of the United States and those of any given state or region. These correction factors are either added to or subtracted from, depending on the signs, the federal census survival rates. The re-

[1] Life tables for the United States and for major regions in the United States are published by the Census Bureau. It is not difficult to construct abbreviated life tables for the various states.

sult is a state or regional survival rate which has the advantages of being sensitive to errors in age reporting on a national basis as well as to mortality factors in the states and regions.

Census survival rates cannot, of course, be obtained by residence groups; and the use of over-all rates for measuring rural-farm migration assumes that mortality rates among rural-farm people and the irregularities in age reporting are not significantly different from those in the total population.

Adjustments in census survival rates because of differences in mortality on farms and in the Nation as a whole would be in order if adequate mortality data were available. However, mortality differences between country and city are not great enough to make much difference in the final results.

In recent years urban and rural mortality rates have come closer together—urban rates still being somewhat higher.[2] The regional differences discussed above are considered much more important than the rural-urban differences.

DERIVATION OF ABBREVIATED SURIVIVAL RATES FOR USE ON A COUNTY BASIS

Survival rates for use on a state and national level are calculated for each five year age group by sex and color. On a county level, however, because of the limited tabulations available and because of the amount of computation involved, it is necessary and desirable to devise abbreviated rates: (1) by age only or (2) by sex and color only. Census tables do show age, sex, and color data for total county population but not for the urban, rural-nonfarm, and rural-farm populations of counties. In these major residential groups census tables show county population by age only in 1930 and by age and sex only in 1940. However, in both censuses, the county populations are tabled by sex and color for the urban, rural-nonfarm, and rural-farm groups.

Survival rates by age only. Using state sex ratios by residence as weights, male and female rates are added together, producing a state table of survival rates by color, age, and residence. Then using white and nonwhite ratios in counties as weights, sets of survival rates by age were derived for counties of varying proportions of white and nonwhite persons. Sets of such rates were prepared for counties having, on the average between 1930 and 1940, 0–4 per cent, 5–9 per cent, etc. of nonwhite persons. Thus for each county it was possible to estimate expected populations, expected increase, and net migration by age.

[2] See Dublin, Louis I., and Lotka, Alfred J., *Length of Life*, New York: Ronald Press, 1936, pp. 90–101. Particularly, Table 16, p. 91.

It is hardly necessary to point out that these county survival rates ignore not only varying sex ratios but also varying mortality rates by counties. The errors thus introduced are relatively small in comparison with the high rates of migration from farms in the various counties. Compare with reference (8), Lively and Taeuber, pp. 164–165.

Survival rates by color, sex and residence. By using age group proportions in each state residence group as weights, survival rates by age, in each sex and color group are combined to form survival rates by residence, sex, color. Age is sacrificed but a residence differential is gained. Application of these rates to the 1930 county populations yields estimates of expected population, expected increase, and net migration by color, sex, and residence but not by age.

Obviously, mortality differences by counties are ignored and it is assumed that age distributions by residence in the counties are not greatly different from the corresponding age distributions in the state. Compare with reference (8), Lively and Taeuber, pp. 164–165.

Validity of county survival rates. As a basis for testing the validity of the two procedures described above, detailed estimates of net migration by color, sex, and age in the total population of six widely scattered North Carolina counties were made. These results were then correlated with the results obtained by applying the abbreviated survival rates to urban, rural-nonfarm, and rural-farm populations of the same six counties. Adding the residential estimates together by age made possible a correlation on an age basis; and then by adding the residential estimates together by sex and color, a correlation by sex and color in the six counties was made possible. The coefficients of correlation were .99 and .93, respectively.[3]

Another test of validity was made by obtaining the correlation coefficient between the net migration obtained by (1) the weighted age survival rates and (2) by the sex, color, residence survival rates. The coefficient of correlation was found to be .99. In this correlation we made a test of the hypothesis that this high correlation might have been due to the size of the county population. The correlation coefficients between farm population per county and net migration as measured by the two methods described above were .73 and .72, respectively. Holding population constant by partial correlation gives a partial coefficient of .98.

Obviously, if a total net migration figure for each county is all that is wanted, then it makes little difference which method is used. How-

[3] These correlations were so high that it was hardly considered necessary to eliminate the factor of "size of population" in the various sex and color groups. However, if anyone is skeptical see next paragraph for a similar test. The standard errors of these coefficients were negligible.

ever, both methods are of value within themselves and have high validity not only for totals but also for sex, color, and age groups within counties.

DEFINING THE RATE OF MIGRATION

The ratio of net migration to the expected population is the best measure of the rate of migration during a decade. In a statistical sense it is best because its base or denominator includes all living persons who could have migrated and the numerator represents the number of persons (net) who did migrate.

What of people who have died? How many of them migrated during the census interval? The only answer this method gives to that question is based on the assumption that while they were alive, they migrated at the same rate as other living persons.

This assumption may, of course, be wrong because morbidity preceding death might affect migration in no small degree. Yet, if the assumption is accepted, then the number of persons dying may be determined by subtracting the number of expected survivors from the persons alive at the beginning of the decade. The estimated number of people who migrated before they died is simply the product of the net migration rate and one-half of the number of estimated deaths. It can only be assumed that the deaths were distributed more or less evenly over the decade and that the average time alive during the decade was five years.

The utility of calculating the number of deceased migrants is questionable, because after all the rate of migration is the more important figure; and it is not at all affected by the calculation of deceased migrants. However, if it is desired to compare the results obtained by this method with results obtained by the annual surveys of the U. S. Bureau of Agricultural Economics then it would be necessary to calculate the deceased migrants (8, pp. 163–164).

MEASURING THE RELATION OF POPULATION PRESSURE TO NET MIGRATION FROM FARMS

Definition of population pressure. A statistical measure of population pressure is the extent, absolute or relative, to which expected population at the end of a decade exceeds or replaces the population of the corresponding age at the beginning of the decade. This definition holds true for all age groups as well as for the total population.

Actually it is the same thing as natural increase or replacement. Replacement rates by age are, in other words, measures of population pressure by age. Replacement rates for a total population or for spe-

cific age groups may be obtained from the same basic material used in measuring net migration.

Illustration. In 1930 there were, according to the United States Census, 786,677 white male persons 25–29 years of age on the farms of the United States. From a younger age group 15–19, coming on to replace these people in 1940 were 1,442,972 survivors, or an excess of 656,295. The replacement rate for this age group was 183.4 per cent. Net migration from farms in this same age group during the decade 1930–1940 was found to be 512,905 or 65.2 per cent of the 1930 population 25–29 years of age.[4]

Correlation analysis. An inspection of similar data for other age groups leads to the conclusion that there is a high correlation between expected population increase and net migration. (*Vide* 3, p. 40.)

The next logical step is to correlate expected population changes with net migration by counties—both for specific age groups and for the total population. This procedure is being followed with the North Carolina data and the results will be described in detail in another article. However, the analysis has been carried far enough to reveal some highly significant and useful relationships.

LITERATURE

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THE RISING LIQUIDITY OF MANUFACTURING COMPANIES AND ITS IMPLICATIONS FOR FINANCING POSTWAR CONVERSION

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Among large manufacturing companies, 1941 was a year of declining cash balances, while 1942 and 1943 have been periods of increasing cash. This shift raises a question whether the present trend can be counted on to continue and, if so, how the liquid position of manufacturing companies at the end of the war will compare with prospective needs for funds in reconversion.

The range of popular opinion on this question is great. On the one extreme stand those who feel that corporations are profiting hugely from the war and who, loosely associating profits with liquidity, infer that the 33 billion dollars of quick liquid assets in the hands of all corporations represent war profits that can be distributed to stockholders after the war.[1] At the other extreme stand the businessmen who reinvest their retained earnings in plant and who see in the consequently declining "current ratio" only an impending disaster. Each time one of these men encounters a comment on the way bank deposits of business firms are looking up, he is sure to cite a company—which he regards as typical—that does not share this deposit experience, or which is anticipating heavy reconversion costs.

In this confusion of facts and their interpretation, there is evidently needed some analysis of recent trends in the financial experience of more than a few companies, together with a projection of these trends forward to the time when termination of war contracts will be the predominant condition. True, the adjustments to be met at that time cannot yet be fully foreseen. Conceptually, however, we can divide these adjustments into two classes: foreseeable adjustments in current assets and liabilities, and other adjustments which are as yet difficult to gauge, such as dismissal wage payments, restoration of industrial capacity for civilian products, outlays for reestablishing market outlets, etc. By estimating roughly the magnitude of the foreseeable adjustments, we can begin to make progress toward visualizing the over-all financing needs of industry in the reconversion period.

* The figures presented in this article were compiled at the Board of Governors, but the views expressed here are those of the author alone and are not to be construed as reflecting the opinion of the Board.

[1] See for example "War Profits and the Press" in *The Nation* for October 9, 1943.

It is with this objective in mind that the present article explores the recent financial experience of large manufacturing companies. In an effort to meet the difficulty that every large company is to some extent a special (and therefore unrepresentative) case, statements for about 500 companies have been tabulated and analyzed for the years 1940–42 and the results have been chained to tabulations prepared by the Securities and Exchange Commission for 892 companies for the years 1935–39.[2] Sales and assets of the 500 companies represent well over half of all manufacturing and mining, and the additional companies included in the SEC tabulation represent another 5 per cent.[3] While these large companies are disproportionately representative of war industries, this bias is probably not undesirable in analyzing the special problem of reconversion needs.[4]

Analysis of recent sources and uses of funds for this group of corporations indicates that several changes are in prospect in the relative importance of component items. During the past two years Government funds have been a major factor contributing to corporate liquidity. Advances on contracts have been large, and some private financing of inventories has been obviated by means of progress payments. In addition, large amounts of short-term funds have been made available, as increases in income tax liability have not had to be paid until a year after the assessed income has accrued. In the latter half of 1943 and in 1944, these sources of corporate liquidity are likely to be less large, but the effect of their decline on liquidity is being offset by lower levels of new investment in plant and working capital. The net result appears to be a continued increase in liquidity, with increasing amounts available for investment in Government securities.

If we assume, for the sake of simplicity, that termination of war contracts will be a prevalent condition by the end of 1944 and try to envisage the adjustments in financial position which this will entail, two significance inferences stand out very sharply. One is that the need of industrial corporations in the aggregate for outside financing will de-

[2] See *Statistics of American Listed Corporations, Part 2*, 1941, pp. 70–71. For the purpose of this analysis, the SEC data have been slightly modified, first by some additions and omissions in the list of companies included, and second to correct apparent inconsistencies in tabulating certain items, especially surplus adjustments.

[3] In 1939 the entire 892 companies held about 58 per cent of the plant and equipment and about 68 per cent of the cash of all manufacturing and mining companies. Superficial comparison of the sales figures for our sample with the totals reported to the Bureau of Internal Revenue suggests a somewhat lower coverage, about 43 per cent. However, allowance should be made here for the fact that many of the larger companies reported to the Bureau of Internal Reveue on an individual-company basis, while providing consolidated reports to the SEC and to the public. Thus the published statements which were used for our analysis wash out an appreciable amount of interaffiliate sales (as well as other income items).

[4] To obtain a more balanced over-all picture, these data are now in process of being analyzed by individual industries and by different size groups.

pend to a major degree on what provisions are available for prompt settlement of the bulk of Government obligations under war contracts. If 75 per cent or more of these obligations can be paid almost at once, many companies will be able to scale down their current liabilities and to build up inventories and receivables for civilian operations, with little or no new financing from banks or the public security markets.[5] If, on the other hand, no such provision for immediate Government disbursement is made, the need for reconversion financing by most companies will be very large, approaching in extreme cases the sum of wartime current liabilities plus new inventories and receivables required for civilian operations.[6]

A second inference of importance from our analysis is that most of the funds to be disbursed nominally by private corporations for conversion purposes will actually have to come from Federal agencies. This follows partly from the fact that wartime inventories and receivables are carried largely for Government account, and also from the fact that a major portion of the present increase in liquidity is being placed in Government securities rather than in cash. This means that, without necessarily alluding to any public works program, we may say the problem of financing industrial reconversion is a problem of Government financing, to a much greater extent than is generally realized.

These broad conclusions, however descriptive of manufacturing companies in the aggregate, do not of course apply to all individual companies, nor even perhaps to the majority of companies. This limitation arises from the fact that prospective deficiencies of funds for some companies in the group tend to be concealed by being averaged in with the surplus liquidity of other companies.

Recent liquidity due mainly to two factors.—In comparison with normal peacetime operations, recent financial developments in manufacturing industries have been dominated by two wartime conditions: private requirements for capital expenditures have been greatly lessened by Government action in providing special plants and by restrictions on private expansion, while sources of short-term funds have been augmented by direct and indirect financing with Government funds.

Nearly half the manufacturing facilities constructed with Govern-

[5] It should be observed that this statement refers only to financing of reconversion costs. Doubtless many companies will find it desirable to begin long-range expansion programs and to initiate the financing of such programs during the reconversion period. The present analysis is not intended to throw light on the amount of such financing.

[6] In reaching this conclusion, allowance has been made for the fact that over half of all bank loans outstanding for war production have been made under the provisions of Regulation V of the Federal Reserve System, and accordingly will not need to be retired in advance of settlement of war contracts.

ment funds is being or will be leased during the war to private companies and has thereby obviated private expenditures.[7] Probably an equally important factor holding down the volume of private expenditures has been restrictions on availability of materials, together with pressure to use existing facilities more intensively. Besides the effect in reducing capital expenditures, this development has helped to reduce overhead costs, increase profit margins, and thereby contribute further to corporate liquidity. At the same time expenditures for renewal and replacement of old equipment have been held down to a minimum consistent with over-all production goals.

Illustrative of the comparative limitation of capital expenditures during the war period are data compiled from financial statements representing about 890 large manufacturing companies for the years 1935 through 1942. Preceding the period of war expansion, sales of these companies increased from 19.9 billion dollars in 1935 to 25.6 billion in 1939, a gain of 5.7 billion; this gain was accompanied and facilitated by gross additions to plant capacity totalling 5.5 billion dollars for the four years. In the following three years, however, sales rose further to 50.6 billion for 1942, an expansion of 25 billion from the 1939 level, while private capital expenditures totalled only 5.2 billion.

These figures are shown in Table I, which summarizes major sources and uses of funds for these corporations during the two periods.[8] It will be seen from the table that the uses of funds for working capital purposes, i.e., for expanding customer credit and inventories, increased more nearly proportionate to the dollar increases in sales (mentioned in the preceding paragraph) than did capital expenditures.

The second major factor contributing to corporate liquidity during the war period has been the increased availability of Government funds. Direct advances on contracts for the manufacturing companies represented in the table have amounted to 2.7 billion dollars. In addition, the typical deferral of payment for income tax liability for a 12 month period has provided these companies with short-term funds amounting to nearly 4 billion dollars over the three-year period. A third form in which Government funds have been made available is progress payments on war contracts. In contrast to the customary peacetime

[7] While most of the remainder is managed by private companies on a fee basis, the output of these plants is not included in the sales data on corporate financial statements. They are therefore assumed to be outside the scope of the present analysis.

[8] These figures represent the *net* inflow and outflow of funds from various sources during the indicated periods. As regards current operations, there is omitted from both halves of the table an amount equal to cash disbursements for current production expenses.

For those interested in relating these changes to the absolute level of the corresponding assets and liabilities, a partial balance sheet is provided in Table IV covering the years 1935–42 with projections for 1943 and 1944.

TABLE I

MAJOR SOURCES AND USES OF FUNDS FOR ABOUT 890 MANUFACTURING COMPANIES DECEMBER 31, 1935–1939 AND DECEMBER 31, 1939–1942*

(in billions of dollars)

	4 years 1935–39	3 years 1939–42
Uses of funds		
Increase in receivables	0.6	3.4
Increase in inventories	1.2	3.8
Capital expenditures	5.5	5.2
	7.3	12.4
Sources of funds		
Increase in:		
Government advances	0.1	2.7
Accrued income tax liability	0.2	3.8
Trade accounts and other current liabilities†	0.5	1.5
Security issues and bank loans‡	1.0	0.8
Sales revenue earmarked for depreciation and other reserves	4.3	5.1
Net profit retained after dividends	2.0	2.8
	8.1	16.7
Balance, change in liquidity		
Increase in cash and temporary investments§	0.8	4.3

* For years 1935–1939, statements for about 890 companies are based on data published by Securities and Exchange Commission in *Statistics of American Listed Corporations*. For later years, data are based on reports for about 500 companies adjusted to a comparable basis. (Reports for 1942 are incomplete and estimates are therefore subject to revision.) The balance sheet data from which this table is computed are shown in Table IV.

† Not including bank loans.

‡ Bank loans, as represented by notes payable, are included with outstanding securities because many companies classify notes and bonds on the basis of maturity rather than kind of creditor. Funds obtained through security issues are adjusted to exclude amounts passed on to nonconsolidated affiliates.

§ While purchase of temporary investments is really a *use* of funds, the fact that they may represent surplus liquidity makes it desirable to classify them with cash as a residual item. For a breakdown between cash and temporary investments in the years 1940–1942, see Table II.

procedure of not billing a customer until his order is completed and shipped, work on cost-plus-fixed-fee contracts has been billed at intermediate stages, thus cutting down on the amount of inventories that need to be financed by the manufacturer. This practice is reflected in Table I by the fact that inventory expansion during the war period has been smaller, relative to the dollar increase in sales, than it was in the prewar period, while the increase in receivables has been somewhat larger.

In these various ways, Government funds have provided about half the increase needed to finance wartime operations of these manufacturing companies. Most of the remainder has been readily provided through the usual internal sources, i.e., revenues set aside for depreciation of plant and equipment and for other costs not yet assessable

("contingency reserves"), and from net income retained after payment of dividends. The net result of these developments has been an increased inflow of funds somewhat exceeding the increased use of funds, so that cash and temporary investments were in 1942 about 100 per cent above 1939 levels. This is about the same percentage increase as shown by sales of these companies.[9]

The growth of corporate liquidity from these sources explains largely why manufacturing companies in the aggregate have made only nominal demands on the security markets and on commercial banks for financing during the war. This has contrasted sharply with the normal financing that would be expected in a peacetime boom. While peacetime tax rates might have left an additional 5 billion dollars or more of income to be retained by the present group of manufacturing companies, their capital expenditures might have been 8 to 10 billion higher. In such a hypothetical situation, and with no Government advances or progress payments, the net new funds required by these companies from banks and security markets during a three-year period might easily have come to 8 billion or more, in place of the 0.8 billion shown in the table.

Appraisal of liquidity in terms of working requirements.—Among casual observers, there appears to be a common tendency to regard the increase in liquidity as an accumulation of "excess" cash. Doubtless there are many instances where this is unequivocally true, especially in the field of trade where inventories have been sold off and cannot be replaced. For large manufacturing companies in general, however, it seems debatable whether the increase in corporate liquidity through 1942 was much larger than the increase required for working capital purposes. The cash component, which may be viewed as the fund required to assure regular payment of pay rolls and other current disbursements in the intervals between receipts from sales, was as low relative to current sales activity at the end of 1942 as at any other year-end[10] back to 1935. As for temporary investments, if we can assume that this type of asset is used mainly as a reserve for accrued income tax liability, it is interesting to observe that at the end of 1942, temporary investments amounted to 83 per cent of the year's income tax liability. This percentage was lower than for any other recent year except 1941.[11]

[9] See Table IV.

[10] This statement is based on a comparison of cash balances at the end of December with estimated cash sales for the month of December. In relation to *annual* sales, cash balances at the end of 1937 appeared to be lower than at the end of 1942. However, in December 1937, manufacturing activity was 24 per cent below the annual average, while in 1942, December activity was 11 per cent *above* the annual average.

[11] In an unpublished manuscript, "Corporate Cash Balances in Peace and War," Professor Friedrich

Appraisal of manufacturing liquidity during remainder of war period.—Among the important implications of increasing corporate liquidity, is its relation to the financial adjustments that may need to be made after the war. In this connection, three questions come to mind on which our analysis of corporate statements may throw some light:

(1) Since the extension of Government funds has been a major factor in recent corporate liquidity, will the tapering off of these funds during the rest of the war mean a decline in liquidity?

(2) How will corporate liquid assets at the end of the war compare with the amounts needed to discharge current obligations and to make other expenditures that may be needed in converting operations back to civilian products?

(3) What are the prospects that banks and security markets will be called on to provide additional funds?

To provide a basis for judging the continuance of corporate liquidity in manufacturing industries, the major factors at work are shown in Table II for individual war years, together with rough estimates of their possible magnitude in 1943 and 1944, assuming continuation of full scale war activity. This table brings out the fact that in 1941, the peak year for private capital expenditures and for inventory expansion, cash balances declined below the previous year's level, and the growth in temporary investments covered only half the increase in income tax liability. In 1942, lower levels of capital expenditure and inventory expansion, together with larger increases in Government advances, facilitated substantial additions to cash and temporary investments.

For 1943 and 1944, private capital expenditures are estimated to decline further, and the tapering off of further increase in manufacturing activity will mean less absorption of funds in customer credit and inventories also. These decreases in use of funds will more or less offset the reduction in funds coming from Government sources—that is from Government advances and from deferred income-tax liability. Funds provided internally, however, will probably continue around previous levels, thus assuring a steady growth in corporate liquidity. In view of this trend, it is a fair inference that there has been no net increase in outstanding notes and securities of these companies in 1943, and that this year some decline will occur as retirements exceed new issues.

These indications point to a residual increase in the cash and temporary investments of these manufacturing companies during 1943 and

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Lutz of the Institute for Advanced Study gauges "normal" liquidity requirements by combining cash and marketable securities, and relating them to total cash disbursements rather than to sales. This procedure seems to have a good deal of merit, though it also raises some problems of interpretation. (Professor Lutz's study is being prepared as part of the Financial Research Program of the National Bureau of Economic Research.)

1944 at about the same rate[13] as in 1942. In allocating the growing liquidity between cash and temporary investments, it has been assumed that cash holdings would be guided by operating requirements and that all the remainder would go into temporary investments, mainly Government securities. This would mean a substantial increase in purchases of Government securities.

TABLE II

MAJOR SOURCES AND USES OF FUNDS FOR ABOUT 890 MANUFACTURING COMPANIES FOR YEARS 1940–1942 WITH ESTIMATES FOR 1943 AND 1944

(in billions of dollars)

	1940	1941	1942	1943*	1944*
(Sales	29.6	41.1	50.6	61.0	65.0)
Uses of funds					
Increase in receivables	0.5	1.3	1.7	1.1	0.4
Increase in inventories	0.8	2.0	1.1	0.2	0.1
Capital expenditures	1.5	2.2	1.5	0.7	0.7
Retirement of notes and securities	0.1	—	—	—	0.3
	2.9	5.5	4.3	2.0	1.5
Sources of funds					
Increase in:					
Government advances	0.6	0.3	1.8	0.1	—
Accrued income tax liability	0.7	2.0	1.1	0.6	0.3
Trade accounts and other current liabilities	0.4	0.6	0.6	0.7	0.2
Security issues and bank loans	—	0.6	0.4	—	—
Revenue earmarked for: depreciation	1.2	1.5	1.6	1.7	1.8
other reserves	0.1	0.3	0.4	0.6	0.7
Net profit retained after dividends	0.8	1.1	0.9	1.0	1.0
	3.8	6.4	6.8	4.7	4.0
Balance					
Increase in cash	0.9	−0.1	0.9	0.7	0.3
Increase in temporary investments†	0.0	1.0	1.6	2.0	2.2

* Rough estimates.

† Includes restricted deposits and excess profits tax refunds, as well as Government securities.

Prospective liquidity after termination of war contracts.—Assuming these guesses as to liquidity trends to be reasonable, the next question is how the accumulated total will measure up in comparison with cash requirements that may be faced by these companies if war contracts

[13] In contrast to this estimate a midyear analysis of financial statements for 80 war producers, published in the National City Bank letter for September 1943, indicated an increase in liquidity for the first half of last year that was considerably greater than the change in all of 1942. This contrast appears attributable to virtual stability in receivables of the 80 companies, as compared to the expansion postulated in Table II. Since these companies represent about one fifth as large a sample (in terms of sales) as the group discussed in the present memorandum, the contrast between their behavior in 1943 and the prospects outlined here for the larger group may reflect differences in the relative coverage of various industries.

should be terminated at the end of 1944. For many companies, contract termination will mean interrupting production lines for several months while facilities are adapted to civilian products. This period of adaptation, together with the building up of new inventories, will require in the aggregate considerable cash outlays. Their amount will be further increased, before receipts from new sales start coming in, by the extension of usual trade credit to customers.

It is not possible at this time to gauge accurately the length of this conversion period nor the aggregate cash expenditures that may be required during it. One reason for this is that there will be no single date when the war contracts of all companies are terminated. Other factors affecting the need for cash and the ability of corporations to provide them include (1) the amount of contingent liabilities carried over from war operations (such as for dismissal wage payments and outlays for reestablishing markets); (2) the amount of discretion allowed manufacturers in cutting pay roll costs immediately after contract termination or alternatively of including interim pay rolls in the amounts due from the Government; (3) the level and distribution of corporate taxable income, which will affect the available amount of tax refunds; (4) the scale on which manufacturers will plan to resume civilian production; (5) the backlog of deferred maintenance and postponed capital replacement; (6) the terms on which Government owned plants, equipment, and surplus material can be purchased or leased, and other factors, some of which are dependent on legislative action in the interim. Questions of timing, as well as the amounts involved, will be important in some industries (such as aircraft) where net working capital is small relative to the scale of wartime operations.

For illustrative purposes, we can, however, obtain some indication of what will be involved at the beginning of the postwar adjustment by assuming that all contracts will be terminated at the end of 1944, and that various balance sheet items will have to be adjusted back to 1941 levels. That is, we may first see what funds would be required to retire current liabilities (including such bank loans for war production as are not under Regulation V), and to build up civilian inventories and receivables. Then we may go on to compare these requirements with the amounts that may be obtained from liquidating wartime inventories and receivables, from opening new accounts payable and accruing other current liabilities (up to the 1941 level of operations), and from drawing down wartime accumulations of cash and marketable securities. For the manufacturing companies in our analysis, these adjustments add up as shown in Table III.

This comparison brings out the strategic importance of Government policy with regard to settlement of war contracts. As shown in the table, if working funds already invested in wartime inventories and receiv-

TABLE III

HYPOTHETICAL REQUIREMENTS FOR FUNDS AND THEIR SOURCES, IN ADJUSTING CURRENT POSITION OF 890 MANUFACTURING COMPANIES TO CIVILIAN BASIS IN 1945

(in billions of dollars)

Requirements for funds	
Retire 1944 current liabilities except bank loans	12.5
Retire bank loans not under Regulation V*	0.5
Replace inventory and receivables (1941 level)†	13.2
Total	26.2
Sources of funds	
New current liabilities (1941 level) except bank loans and Government advances	6.1
Draw down cash and marketable securities to 1941 level‡	7.7
Liquidate 1944 inventory and receivables†	17.8
Total	31.6
Subtotal, excluding inventory and receivables	13.8
Subtotal, including 75 per cent of inventory and receivables	27.2

* Total bank loans for war production not arranged under Regulation V may be about 1.5 billion at the end of 1944, and it is assumed that one third of these will be to the large companies included in the present analysis.

† To the extent that some wartime inventories will be retained for use in civilian production, this item will be smaller than shown here, and the totals, both of requirements and of sources, will be correspondingly lower.

‡ Including postwar refund of excess profits tax.

ables should be frozen after termination of contracts, manufacturers would need additional financial aid for about half their total working capital requirements in the transition period. On the other hand, if arrangements should be concluded for immediate payment to manufacturers of the bulk of their contract claims, say 75 per cent or more, these companies would (in the aggregate) be able to meet their working capital requirements, and would require outside financing only for such other reconversion costs and capital expenditures as are not mentioned in the table.

Finally, as an outside limit, it appears that complete settlement for wartime inventories and receivables within a year might facilitate the release of some 5.4 billion dollars for such special war costs. This sum would probably be augmented during the first transition year by additional funds, amounting perhaps to 1 billion dollars from revenue allocated for depreciation and another billion from retained net income.[13]

[13] Some additional amounts may also be obtained as income tax credits under the revenue code provisions for carry-backs and for accelerated amortization of defense facilities after termination of the

Thus in the event that settlement of Government obligations could be effected expeditiously, the adjustments in current position plus current earnings of these companies, covering over half of all manufacturing industry, would provide 7 to 8 billion dollars for various contingency costs and new capital expenditures, without resort either to the banks or to security markets for further funds.

TABLE IV

MAJOR OPERATING ASSETS AND LIABILITIES FOR ABOUT 890 MANUFACTURING COMPANIES FOR DECEMBER 1935–42 WITH PROJECTIONS FOR 1943 AND 1944

(in billions of dollars)

	1935	1936	1937	1938	1939	1940	1941	1942*	1943†	1944†
Major operating assets										
Net property account‡	13.31	13.69	14.50	14.60	14.58	14.87	15.58	15.50	14.50	13.40
Cash	2.33	2.35	2.16	2.84	3.31	4.19	4.07	4.99	5.70	6.00
Temporary investments§	1.08	.99	.83	.77	.89	.93	1.89	3.52	5.70	7.70
Inventories	4.96	5.63	6.60	5.89	6.15	6.90	8.89	9.99	10.15	10.30
Receivables	1.98	2.37	2.32	2.27	2.58	3.04	4.30	5.95	7.10	7.50
Major operating liabilities										
Accounts payable	.77	.98	.89	.81	1.02	1.23	1.67	2.05	2.45	2.60
Income tax liability	.27	.45	.54	.30	.47	1.15	3.12	4.24	4.80	5.10
Government advances	—	—	—	—	.10	.70	1.00	2.80	2.90	2.90
Other current liabilities	.72	.85	.88	.86	.96	1.10	1.28	1.47	1.80	1.90
Surplus reserves	.80	.84	.86	.82	.85	.93	1.18	1.64	2.20	2.90
Outstanding securities¶	16.66	16.87	17.55	17.76	17.68	17.55	18.13	18.50	18.50	18.20
Selected income items										
Sales	19.90	24.60	28.24	22.61	25.58	29.59	41.11	50.64	61.00	65.00
Depreciation expense	.94	.99	1.08	1.07	1.15	1.24	1.45	1.60	1.70	1.80
Net income	1.50	2.33	2.52	1.24	2.06	2.48	2.93	2.42	2.66	2.60
Dividends declared	1.01	1.70	1.88	1.13	1.44	1.66	1.81	1.51	1.66	1.60

* Preliminary.

† Estimate based on continuance of full scale war production.

‡ After deducting depreciation reserves.

§ Includes restricted deposits and post-war refund of EPT, as well as tax notes and other government securities.

¶ Includes notes payable but excludes amount equal to investments in affiliates.

This, of course, does not necessarily mean that there will be no outside financing by these companies in the reconversion period. Doubtless there will be many individual companies which will need to make reconversion expenditures in excess of their available cash reserves, and others which will wish to initiate the financing of new products or production techniques. It does not seem possible at this time to estimate how large this financing may come to.

emergency period. For present purposes, however, little account need be taken of the former possibility, because amounts from this source would be more than offset by failure of net profits to reach the level assumed here.

THE CONCEPT OF PRODUCTIVE ACTIVITY

By Irving H. Siegel*

This paper is devoted to the discussion of various aspects of the concept of productive activity. This concept, like many we seek to quantify, may be represented in various ways, some of which are more appropriate than others. Ideally, it may be represented by the input of productive services or by the net economic product to which that input corresponds. Both measures describe the same activity—the creation of valuable utilities—but from different sides and in different terms. As will be seen later, both may be made almost identical for a single period, but indexes will usually diverge. Since such measures may be difficult or even impossible to construct in practice, more or less correlated measures—like the volume of raw materials consumed or the volume of goods completed or shipped by establishments—are commonly substituted. Only by giving some precision to the concept we wish to measure can we make rational choices among such substitutes or appraise the differences between them and ideal measures.

In this paper, the representation of activity in terms of both input and product will be treated, but more attention will be given to measures of the latter type, which are conventionally preferred and probably more significant from an economic standpoint.[1] For the sake of brevity and simplicity, the discussion will be limited to manufacturing; and no reference will be made to many familiar problems and controversial issues of economic measurement. No choice, for example, will be made among possible definitions of value added or income originating in an industry. Index-number problems, such as the selection of a formula and weights and the satisfaction of certain algebraic tests, will largely be ignored. And certain temptations arising in the contemplation of "fundamentals" will be resisted: efforts at statistical vivisection will not be declared futile simply because money is a defective indicator of economic value where perfect competition does not reign, because other indicators of value have even more serious limitations, because prices and other weighting factors are not really independent of quantities, and because periods characterized by different tastes, commodities, income distributions, and technologies are essentially noncomparable.

* On military leave from U. S. Bureau of Labor Statistics.

[1] For an exchange of views on indexes of input (and other subjects) by M. A. Copeland and E. M. Martin, S. Fabricant, and M. Friedman, see *Studies in Income and Wealth*, Vol. II (New York, 1938) pp. 85–135.

ACTIVITY IN TERMS OF PRODUCT

An ideal measure of the productive activity of an establishment or industry should reflect the transformation of raw materials into partly finished as well as completed goods, and the further elaboration as well as the mere completion of goods already in process. It should be relatively neutral to the time unit selected for measurement and the time cycle of the productive process, to the degree of integration of manufacturing facilities, and to the degree of interdependence of establishments classified in the same or different industries. Though these specifications introduce no special difficulties into the measurement of input, they do impose certain restrictions on measures of product intended to reflect activity. The remainder of this section will be devoted to the consideration of activity in terms of product.

In accordance with the view expressed above, the accomplishment of a plant should be described, if possible, not in terms of its final products, but in terms of subproducts of particular operations, sequences of operations, or departments.[2] Thus, each type of finished good should be regarded as a complex of subproducts associated with, say, the unitary processes shown on a more or less detailed flow chart. The characteristic subproducts of auxiliary departments—like the power plant—should be taken into account as well as the subproducts of operating departments. Different goods made in the same plant should, in general, be treated as distinct sets of subproducts, but homogeneity may be assumed for similar or joint operations. The same goods made by dissimilar methods—for example, in different plants—may be regarded as different goods; or be treated as complexes of comparable subproducts by the appropriate grouping of sequences of operations directed toward comparable ends.

Evidently, even one good may be described by alternative systems of subproducts. Criteria may, however, be established to distinguish acceptable from unacceptable systems. The time required for each of the unitary processes defining a subproduct system should be shorter than the period of measurement. The more refined the process intervals, the more precise the evaluation which can be made of work done on those units of goods which do not go through the complete fabricational cycle during a period.

Measures based on appropriately weighted subproducts would reflect the volume of activity during a period much more satisfactorily than the common aggregative measures of gross product, which are

[2] S. Carlson, in *A Study of the Pure Theory of Production* (London, 1939), pp. 10–11, uses the term "technical unit" to define the distinctive stages of an establishment's activity.

based merely on the volume of maturing goods and unit-value weights. They are also superior to the measures of net product often regarded as ideal—in which the quantities of maturing goods are weighted by value added per unit during the complete production cycle. It is important to observe that the volume of *complete* plant products corresponding to the amounts of the several subproducts made during a period may differ significantly from the volume of goods merely *completed* during that period. Measures based on finished goods are unreliable for periods in which relatively more subproducts are made at the earlier stages of the productive process; for plants or industries which are not completely integrated or which undergo changes in degree of integration; and for plants or industries having a long production cycle compared to the measurement period.

The approach outlined here is not incompatible with the modern economic view of production and the theory underlying the measurement of national income.[3] A somewhat similar approach is suggested by H. S. Jevons' treatment of "work" as the "amount of labor in terms of commodity produced." His "commodities" are really subproducts or units of accomplishment:

> Work is not always of the nature of actual making of commodities: it may consist merely of moving commodities from place to place, or of making such an insignificant portion of the object planned—as for instance, bolting a plate on a ship's hull—that the labor of such a period of time as we may wish to consider does not produce a commodity; or again it may be devoted to the destruction of things—as pulling down houses; or to the removal of discommodities.[4]

A number of difficulties, in addition to the unavailability of sufficient data in suitable form, would be encountered in any attempt to measure activity in terms of subproducts. Some awkwardness, for example, would arise in the treatment of acceptable work done on goods which are not ultimately used as intended—say, because of imperfections, design changes, or the cessation of hostilities. It is impossible to determine beforehand just what activity will contribute, not to the satisfaction of wants, but to the diversion of resources. A similar problem arises in measures based on finished goods, but is usually ignored.

Activity cannot readily be expressed in terms of subproducts or units of accomplishment in the absence of a certain uniformity or repetitiveness of operations. The work of some auxiliary departments—like those engaged in maintenance, construction, or making tools, dies, jigs, and fixtures—is not standardized. The same difficulty may be en-

[3] See, for example, the very illuminating first chapter of S. Kuznets, *National Income and Its Composition, 1919–1938* (New York, 1941), Vol. I. The discussion of the meaning of "produced" and the timing of production, pp. 46–50, are particularly relevant.

[4] H. S. Jevons, *Essays on Economics* (London and New York, 1905), p. 164.

countered in attempts to measure work done in certain operating departments, in new plants, in plants converting from one type of product to another, and in plants or industries in which the nature of the activity varies according to season. Finally, there are temporal changes—in the process or output of an establishment and in the establishments composing an industry—which must be taken into account in the definition of a subproduct system. Where devices already discussed are inadequate, it may be feasible to express activity in different periods in terms of hypothetical standard work units. At worst, the attempt to measure activity in terms of product may be abandoned in favor of the measurement of input.

MEASURES OF ACTIVITY

Activity in a single period may be represented by measures of input and net product which are virtually equal. Thus, if money is used as a common measure, it is possible to have for the period t_0

$$\sum v_0 s_0 = \sum p_0 q_0 - \sum P_0 Q_0, \tag{1}$$

where the v_0 and s_0 represent average prices and quantities of productive factors; p_0 and q_0, the average prices and quantities of the subproducts made in t_0; and P_0 and Q_0, the prices and quantities of subproducts and of products and services of other establishments and industries consumed in t_0. Equality cannot obtain unless the subproducts are so narrowly defined that all the work done during the period on stocks of unfinished goods is automatically recorded. The prices p_0 and P_0 must also be such that the difference between them embraces exactly those services which are included in the left-hand member of the equation. Incidentally, the same result would be achieved if zero prices were assigned to all materials and services obtained from other establishments or industries; only consumed subproducts of the establishment would have non-zero P_0, and the p_0 would include only value added within the establishment.

If the subproducts are so defined that one unit of each corresponds to one unit of a consumed antecedent subproduct, material, or service, then the right-hand member of (1) may readily be written as the sum of quantities weighted by unit value added:

$$\sum p_0 q_0 - \sum P_0 Q_0 = \sum q_0 \left(p_0 - \frac{P_0 Q_0}{q_0} \right). \tag{2}$$

If a one-to-one correspondence does not exist, then the right-hand member of (2) must be written in somewhat more complicated form; the $P_0 Q_0$ must be replaced by a sum, and, accordingly, the sum $\sum P_0 Q_0$ on the left must be replaced by a double sum. This complication is often overlooked in the literature.

Similar equations may be established for any single factor or combination of factors intended to represent activity. Since payments to such factors as capital and salaried labor are fixed for short periods, it may be preferred, for example, to consider only wages or the man-hours of wage earners. It may also be preferred to substitute depreciation charges for interest if the former are computed on the basis of output rather than time.

If we wish to represent activity in t_0 by man-hours, we may write

$$\sum m_0 = \sum q_0 l_0, \tag{3}$$

where the m_0 signify man-hours added, q_0 the quantities of subproducts, and l_0 the corresponding unit labor requirements. The left-hand member of (3) may also be written as the difference between cumulated man-hours at successive stages of the productive process. The man-hours corresponding to goods or services of other establishments or industries are, of course, ignored—that is, counted as zero.

If we wish to represent activity by wages, we may write

$$\sum m'_0 r'_0 = \sum q'_0 l'_0 r'_0 = \sum q'_0 c'_0, \tag{4}$$

where the m'_0 represent man-hours, but not necessarily the same as the m_0 in (3); the q'_0, l'_0, and r'_0 represent quantities of subproducts, unit labor requirements, and average hourly earnings, respectively; and the $c'_0 = l'_0 r'_0$ are unit labor costs corresponding to the q'_0. Keynes uses the equivalent of the input measure, $\sum m'_0 r'_0$, to reflect the output of individual establishments; his m'_0 and r'_0 refer to the quantity and remuneration of labor of different skills.[5] From our point of view, the q'_0 implied in this case are subproducts relating specifically to these skills.

Indexes of activity may be defined as ratios of expressions such as those above for the periods t_i and t_0. More satisfactory indexes are obtained if all of the weights are standardized to refer to one period, such as t_i, t_0, or even a hypothetical one. Indexes of input and product with standardized weights are generally unequal, even if equations like (1), (3), and (4) are satisfied for t_i and t_0. An input-product equation for one period is destroyed by the introduction of weights for another. The process of standardization is equivalent to "deflation" of the ratio of the unadjusted expressions for t_i and t_0 by an index which is conceptually and algebraically appropriate.

The indexes of input and output with t_0 weights corresponding to (1) are

$$\frac{\sum v_0 s_i}{\sum v_0 s_0} \text{ and } \frac{\sum p_0 q_i - \sum P_0 Q_i}{\sum p_0 q_0 - \sum P_0 Q_0}, \tag{5}$$

[5] J. M. Keynes, *General Theory of Employment, Interest, and Money* (New York, 1936), pp. 40–45.

respectively. The product index may also be written as

$$\frac{\sum p_0 q_i - \sum P_0 Q_i}{\sum p_0 q_0 - \sum P_0 Q_0} \qquad \frac{\sum q_i \left(p_0 - \dfrac{P_0 Q_i}{q_i}\right)}{\sum q_0 \left(p_0 - \dfrac{P_0 Q_0}{q_0}\right)} \tag{6}$$

if (2) is meaningful, and in a more complicated form if (2) is not. An approximation to (6) is the aggregative index,

$$\frac{\sum q_i \left(p_0 - \dfrac{P_0 Q_0}{q_0}\right)}{\sum q_0 \left(p_0 - \dfrac{P_0 Q_0}{q_0}\right)} \tag{7}$$

with t_0 weights. These indexes resemble those shown by Fabricant[6] for an industry, but differ in at least one important respect: the quantities here include subproducts, some of which may be consumed in further fabrication in the same plant during the same period.

The unadjusted index of wage-earner man-hours,

$$\frac{\sum m_i}{\sum m_0}, \tag{8}$$

is a practical and widely used measure of input changes. Although man-hours for different periods are often compared directly, it may be preferred to standardize them first, to eliminate interperiod qualitative differences. Thus, productivity or unit labor requirements may first be standardized for a definable set of tasks, a common system of subproducts on which the labor is, or could be, expended in t_i and t_0. If unit labor requirements are standardized to refer to t_0, we have

$$\frac{\sum m_i \dfrac{l_0}{l_i}}{\sum m_0} = \frac{\sum m_i \dfrac{\pi_i}{\pi_0}}{\sum m_0} \tag{9}$$

where the $\pi_i = 1/l_i$ and $\pi_0 = 1/l_0$ represent productivity, or output per man-hour for the different subproducts. This adjusted index of labor input is really a measure of product which corresponds to the right-hand member of (3), for

$$\frac{\sum m_i \dfrac{l_0}{l_i}}{\sum m_0} = \frac{\sum q_i l_0}{\sum q_0 l_0}. \tag{10}$$

[6] S. Fabricant, *Output of Manufacturing Industries, 1899–1937* (New York, 1940), pp. 23–33. See also his article on "Problems in the Measurement of the Physical Volume of Output by Industries," this JOURNAL, September 1938, pp. 564–570.

If all the π_i/π_0 or l_0/l_i are equal to unity, (9) or (10) is equal to the unadjusted measure (8).

The adjusted man-hours index may, of course, be derived alternatively by the deflation of the unadjusted index by an appropriate index of unit labor requirements, or by the multiplication of the former by the reciprocal of the latter, which is an index of productivity. As will be seen in the next section, it is often erroneously assumed that any index presenting productivity is satisfactory, that the derived production measure is unique, and that a proper production index may somehow be obtained by deflation where no subproduct system common to t_0 and t_i is, or can be, specified. The symbol $\sum q_i l_0$ in (10) is meaningless if the $q_i l_0$ do not refer to the same subproduct system as the $q_0 l_0$ in $\sum q_0 l_0$. In cases of discontinuity of a plant's or an industry's activity, continuity in types of labor employed may provide some basis for defining a common subproduct system. If the nature of the work force has also changed radically, no satisfactory adjustment for presumed productivity changes between t_0 and t_i may be possible.

A measure of labor input which is preferable to the unadjusted man-hours index (8) is suggested by the first term in (4). Using t_0 weights, we have

$$\frac{\sum m'_i r'_0}{\sum m'_0 r'_0}. \tag{11}$$

Whereas (8) implies the homogeneity and additiveness of all man-hours, (11) differentiates them on the basis of hourly earnings. Another measure of labor input, in which adjustment is made for differences in unit labor cost between t_0 and t_i, is equivalent to the index of product suggested by the second and third expressions in (4):

$$\frac{\sum m'_i r'_i \dfrac{l'_0 r'_0}{l'_i r'_i}}{\sum m'_0 r'_0} = \frac{\sum q'_i l'_0 r'_0}{\sum q'_0 l'_0 r'_0} = \frac{\sum q'_i c'_0}{\sum q'_0 c'_0}. \tag{12}$$

In practice, (11) and (12) are even more difficult to approximate than (9) and (10). The former, incidentally, is equivalent to the quotient of the payrolls index and an appropriate index of hourly earnings, and the latter is equivalent to the quotient of the payrolls index and an appropriate index of unit labor cost.

The various indexes of input or net product discussed above will usually differ from each other and from corresponding indexes with weights referring to other periods. The conditions determining the relative magnitudes of aggregative indexes for the same factors or subproduct systems but with different weights have been considered by the present

writer in other articles in this JOURNAL.[7] It may be of interest to note here the relationship existing among product indexes with different factor weights (expressed in money). In a single period, say t_0, it is obvious that

$$\sum q_0 w_0 = \sum q_0 a_0 + \sum q_0 b_0 + \sum q_0 c_0 + \cdots , \tag{13}$$

where the w_0 represent unit values added, and the a_0, b_0, c_0, $\cdots$ represent factor costs per unit of product, so that $w_0 = a_0 + b_0 + c_0 + \cdots$. The product index with unit-value-added weights, which corresponds to (7), may then be written as follows in terms of the indexes with factor weights:

$$\frac{\sum q_i w_0}{\sum q_0 w_0} = A \frac{\sum q_i a_0}{\sum q_0 a_0} + B \frac{\sum q_i b_0}{\sum q_0 b_0} + C \frac{\sum q_i c_0}{\sum q_0 c_0} + \cdots , \tag{14}$$

where $A = \sum q_0 a_0 / \sum q_0 w_0$, etc. and $A + B + C + \cdots = 1$. This result, which may be extended to refer to an aggregative index of gross product, is equivalent to the "general linear equation" derived by Roy in another connection—the integration of Divisia's differential index-number formula.[8]

SOME CURRENT INDICATORS OF ACTIVITY

In the light of the foregoing, we shall now consider briefly some current series which are intended or interpreted as measures of activity in terms of product. First, we shall comment on indicators of the accomplishment of war industries. For obvious reasons, emphasis in these industries is placed on deliveries of finished goods—acceptances by government agents. A satisfactory delivery rate, however, may not signify a satisfactory activity rate, on which future deliveries depend.

In one major war industry, shipbuilding, a distinction is made between deliveries and work done. The Navy and the Maritime Commission not only record the number and tonnage of vessels delivered each month but follow peacetime Census practice in estimating accomplishment during the same period. Although the time interval between keel-laying and delivery has been reduced considerably, it is still too long, at least in the case of larger vessels, for a high correlation between activity and deliveries. In the airplane assembly industry, the same Census practice has been abandoned, and only deliveries are reported. Under conditions of near-capacity production throughout a large section of our economy, the time cycle for the fabrication of many ma-

[7] "The Difference between the Paasche and Laspeyres Index-Number Formulas," September 1941, pp. 343–350; and "Further Notes on the Difference between Index-Number Formulas," December 1941, pp. 519–524.

[8] R. Roy, "Les Indexes Economiques," *Revue d'Economie Politique*, 1927, pp. 1272–1274.

terials and parts as well as for the assembly of complex equipment may be sufficiently long to suggest caution in the interpretation of data on shipments or deliveries.[9]

A few instances in which deliveries proved unreliable as indicators of activity will now be cited from press reports. The War Production Board munitions index (November 1941 = 100), which apparently is based on work done in shipyards and on value-weighted quantities of goods delivered, rose from 435 in November 1942 to 496 in December but receded to 457 in January 1943. The explanation was given that "assembly lines were stripped . . . to produce as many units as possible" before the year-end, so the record for January was "adversely affected" by December's "excellent showing."[10]

When the WPB index showed no change in munitions output between April and May 1943, dissatisfaction with the "yardstick" was expressed. Curiously enough, an objection was raised against the representation of shipyard activity by work done, which lagged behind deliveries:

> To officials who have been preening themselves upon the delivery of a record 100,000 deadweight tons of merchant ships during May, it came as a bitter jolt to discover that the production report showed the "value of work done" in shipyards for the month had declined 4 per cent compared with April.
>
> The "value of work" measurement was adopted early in the war when construction was getting under way and was then considered a fair way of reflecting progress made. Its worth is open to question from WPB officials now, however, when record launchings of ships do not show up in proper proportion in the production picture.[11]

In June 1943, the displacement tonnage of naval vessels delivered rose 13 per cent above the May level to a new peak; "because 'the value of work put in place' in shipyards is used in measuring output, however, the month's report showed a 3 per cent decline."[12]

Plane deliveries have frequently been affected by temporary bottlenecks in subsidiary industries and by accidental factors which have little bearing on activity in assembly plants. In October 1942, plane deliveries fell 5 per cent below the number for the preceding month. The decline reflected "the bunching of deliveries on Sept. 30, many of which under normal circumstances would have been delivered in Octo-

[9] For illustrations of time requirements for materials entering into various war goods, see American Iron and Steel Institute, *Steel Facts*, June 1943, p. 5, and August 1943, p. 5, and *Aero Digest*, October 1943, pp. 222, 224.

[10] *New York Times*, February 3, 1943.

[11] *New York Times*, July 18, 1943.

[12] *New York Times*, July 31, 1943.

ber, and the grouping of deliveries on Nov. 1, many of which would have been included in October shipments." One large manufacturer indicated that weather interfered with test flights so that 59 planes completed in October "were not accepted until Nov. 1."[13] The total reported for December 1942 suggests other problems in interpretation. The figure for that month included "several hundred planes which were accepted but went into the 'pool' on the last day of the month." The planes in the "pool" may not be in flying condition; they may lack "some part—a propeller, wheels, instrumentation or other essential items."[14]

In conclusion, some comments will be made on the Federal Reserve indexes of manufacturing activity (1935–39 = 100), which are compiled monthly.[15] These measures are based on quantities of goods made per scheduled workday in each month; on consumption, sales, deliveries, and shipments; and on machine-hours and man-hours, adjusted in most instances to show probable changes in volume of product. The weights used in the composite manufacturing index and in the index of "industrial production," which includes both manufacturing and mining, represent value added in 1937. In September 1941, the scope of the composite indexes was broadened to include government manufacturing activity in shipyards, arsenals, and quartermaster depots, but no weights were formally assigned to the series representing such activity.

Despite the lavish application of ingenuity to intractable data, many of the Federal Reserve measures may fail to reflect reliably the course of activity in terms of product. The weighted quantities of electric and other types of steel may not, for example, reveal the changes taking place in steelworks, rolling mills, and other industries in the iron and steel group. The activity of fabricators may also be inadequately portrayed by the volume of material shipped to or consumed by them (even if the amounts are first adjusted for timing), or by their shipments of finished goods, or by the volume of goods completed.

A striking feature of the Federal Reserve indexes since the 1940 revision is the inclusion of adjusted man-hours to represent current activity in industries having a long production cycle, making numerous or heterogeneous goods, or manufacturing products which differ from their peacetime output. After the December 1941 revision, man-hours series accounted for 38 per cent, and after the October 1943 revision

[13] *New York Times*, December 8, 1942.

[14] *New York Times*, February 3, 1943.

[15] The discussion of the Federal Reserve indexes is based largely on the descriptions given in the *Federal Reserve Bulletin*, August and September 1940, September 1941, and October 1943.

41 per cent, of the base-period aggregate for private manufacturing. Such series account for even greater percentages of aggregates for more recent periods and of aggregates which include government manufacturing.

After the October 1943 revision, the indexes for government manufacturing and for industries representing about 22 per cent of the 1935–39 private manufacturing aggregate are based on man-hours adjusted directly for presumed productivity changes. The "allowances" for "broad changes in output per man-hour," however, leave much to be desired. They are derived independently from various types of data, are based on no particular subproduct system, and may yield a result which differs considerably from the theoretically ideal product measure. Even if ideal data were available, it might be difficult or impossible to define a common subproduct system for the measurement of productivity change in an industry which has converted to war production, makes complex goods of changing design, subcontracts parts, etc. Finally, the assumption that short-term productivity movements are smooth and capable of extrapolation appears untenable, no matter how productivity is defined.[16]

Indexes for industries representing about 17 per cent of the 1935–39 aggregate for private manufacturing are based on monthly man-hours adjusted to quarterly or annual levels determined from production and other data. Even if such data give reliable indications of activity changes in terms of product between quarters or full years, they may not be conceptually appropriate for shorter periods. The adjustments may not improve the month-to-month changes shown by man-hours. The index for rubber products, representing less than 2 per cent of the base-period manufacturing aggregate, is based on unadjusted man-hours. This series corresponds to an index of product if a standard subproduct system can be defined and the correlative productivity measure has the constant value unity.

[16] It may readily be verified that, even when crudely defined as the volume of goods completed or shipped per man-hour, productivity fluctuates from month to month. The average effectiveness with which labor is utilized in making subproducts is influenced not only by mechanization and technological advances but also by a host of short-term factors: temporary idleness caused by faulty scheduling, material shortages, design changes, conversion of facilities to production of other goods, accidents, or strikes in subsidiary industries; hiring of labor for training; hoarding of workers who may later be released or more productively employed in the same establishments; wastage of labor on rejects and expenditure of additional effort on salvage; etc.

SOME PROBLEMS OF STATISTICAL EDUCATION AND TEACHING*

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I. While Dr. Stuart A. Rice, in his article on statistics in the United States during the war,[1] gives us the idea that in the United States there is appearing, in certain fields of action, what might be termed an exaggeration of the statistical mind ("espíritu estadístico"), we must confess that the situation is quite the opposite in many of the other countries of this hemisphere.

From Mexico to the Argentine we can find economic, political, and social publications in which the authors complain of the lack of reliable figures relating to one urgent problem or another and in which they emphasize the absolute necessity for a better organization of the statistical services of their respective countries.

Many of these countries have attained a high degree of industrialization and of economic life in general. Nevertheless, it may be said that their statistical organizations are still at a level inferior to that attained by European countries smaller in population and less important in international trade.

II. Analyzing the possible reasons for this state of things, we may present the following items as mainly responsible for the absence of the "statistical mind" in many countries of Latin America.

1. The colonial economy continued to be the typical form of economic organization in most of the countries of Latin America for a long time after the attainment of political independence, and even now it has not altogether disappeared. The colonial economy may be defined, for the purposes of this article, as that state of things in which the large businesses, plantations, lands, mines, etc., are found in the hands of foreigners either resident in foreign countries or living only for the time being in these American countries. The sole object of these business enterprises is to make the largest possible profits in the least possible time. They are not concerned with building up a permanent

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[1] United States Statistics in Wartime, *Estadística*, Vol. I, No. 1, p. 31.

organization or with extensive and costly economic investigations undertaken to find out small differences in the expenses of operation or of administration or of improvements. The profits of these undertakings have been in general so large and so quickly realized that it would have been an expenditure absolutely unnecessary to invest money in scientific statistical investigations, analysis of markets, possibilities for the distant future, etc.

2. Another reason without any doubt is the extensive political instability which has characterized the history of Latin America since the wars for independence. We must never forget that statistics, especially in the economic and social fields, cannot possibly develop except where there is a well organized public administration with a fairly extensive continuity. It is exactly the lack of this continuity in public administration (civil registers, industrial records, immigration, emigration, morbidity, etc.) which interrupts any historical series sooner or later. It would be difficult in most cases to establish with certainty the figures for immigration, birth rates or death rates, or circulation of money, for example, as far back as the year 1860.

3. If these two circumstances have their foundation in history, they have created a state of thinking which is in the highest degree of the present and which is characterized by just this lack of the statistical mind, of respect for figures. The public official and the man in the street go on thinking in indefinite quantities, in terms of "much" and "little." If the public official in the United States sometimes wastes time because he is afraid to adopt some measure without having as a base a pile of statistical tables, many of them perhaps unnecessary, quite the opposite happens in many cases in Latin America. Measures are adopted without any statistical base or with one very unsatisfactory, but without losing time. Does it always depend on the particular circumstances, which of these two extremes is the more dangerous?

III. It is evident that this state of things cannot be changed overnight by decrees, laws, Pan American agreements, or scientific congresses alone. The statistical way of thinking can be attained only as the result of a broad campaign of education comparable with certain campaigns undertaken in the fight against certain epidemics or unhealthy and antisocial customs. This inter-American statistical campaign will involve two principal fields of action.

a. The statistical education of the public in general. In addition to the general advertising program always undertaken by national governments when there is in prospect a census or new fiscal or administrative procedures, the statisticians of all the American countries would have

to contribute to the building up of a "respect for figures." By means of conferences, statistical societies, publications, etc., we must demonstrate the absolute necessity for statistics in all branches of public, economic, political, and even individual life. The manufacturer or merchant must understand that the figures which the Statistical Office asks him to furnish are not professional secrets, but that these same data, worked up and published together with others of the same kind, will help him understand the economic situation and facilitate decisions in his own business. Newspaper men in their publications, and politicians in their speeches, would have to discuss the current questions, using statistical data when possible, and not only to use statistical data in support of their own opinions but also to call attention to the lack of exactness in such data when they are trying to attack the opinions of an opponent. In other words, statistics must undertake a sales drive in all countries where it is needed. And it appears that there are many of these.

b. If by this statistical education we create the demand for our products, which are statistical figures, we must logically concern ourselves to an equal or greater degree with their production. And we cannot produce results without having a personnel sufficient in number and adequately prepared. The next thing to be considered, then, is effective statistical instruction. This instruction must have for its aim the development of a well qualified statistical personnel in the countries of the Americas, including in this concept of personnel, not only the men who direct the central offices and the principal subdivisions, but also the employees of all ranks in the hierarchy, from the lowest to the highest. The necessity for a complete "vertical" coverage in the system of teaching will be understood if we compare the statistical office with a hospital or a factory. It is not sufficient to have a physician of the highest qualifications as head for the one or a competent engineer for the other. Neither of these can produce good results if he is not supported by subordinates equally competent and well qualified. The physician cannot attend to his patients without the aid of well-trained medical assistants, pharmacists, nurses, and even cooks; the industrial plant will be very soon paralyzed if the chief engineer does not have the aid of experienced technical assistants, draftsmen, mechanics, and office workers. For the same reason it is absolutely not enough that the director of a statistical office or the chief of a section understand well the matters under his jurisdiction. In order to work effectively the whole statistical personnel must have specific training, graduated according to their various functions and responsibilities.

IV. What is the present state of statistical instruction? In general, this subject appears only in the programs of the universities (faculties of economic, social, and commercial science, etc.). It might be said as a general rule, with many exceptions, that the following shortcomings may be observed in this university instruction and in the university programs:

a. The number of students and the number of persons trained by the faculties is necessarily limited in comparison with the present needs and even more if we think of the future.

b. A graduate of the university bears the title of doctor or "licenciado" and is no longer willing to accept the humble task of assistant in a statistical office. And it is exactly in the lower stages of the hierarchy that there is the greatest lack of qualified personnel.

This program of statistical instruction cannot be considered as an adequate preparation (speaking in general terms) for the professional activities of the statistician.

One should not make so serious a statement as this without giving reasons in support of it. We may therefore point out the following as the principal deficiencies in many of the statistical programs in the universities, European as well as American:

1. The lack of sufficient time devoted to actual practice. In some programs statistics is given only for a half year, without special sessions for practice (laboratory work, so called) or even for analyzing a reasonable volume of specific statistical data.

2. A statistical program purely mathematical. There are programs which belong rather in a faculty of pure mathematics than in one of economic science. The student who follows these programs can perhaps, once he has completed the course, explain the derivations of some of the most complex formulas used in higher actuarial mathematics or in the fitting of biometric curves, but he will be completely unable to organize the collection of statistics of foreign trade, of a bank, of a business, or of a public health department. He will be able, eventually, to work out correlations, more or less artificial, but he will not be able to read and compare the statistics of imports of two countries which use different methods for determining the basic values in commercial transactions. In many cases, after having devoted several years to practical work, even in high positions, he will admit that 80 per cent of the knowledge which he obtained in the university represents dead weight for him, and that it is neither needed nor of any possible use.

We can be sure that this exaggerated notion of the importance of pure mathematics in statistical training comes to us from a period in

which statistics was applied only in demography, biometrics, and in the exact sciences, when it was sought at all costs to elevate statistics to the rank of a sister of that same mathematics. This concept is no longer current. Statistics has been converted into an auxiliary science applied in a great number of practical and scientific fields; and for reasons which cannot be explained here for lack of space mathematics must give ground, in the practical application of statistical methods, to a knowledge of organization, administration, filing (classification), and above all, to a knowledge of the particular material to which the statistical investigation relates.

This exaggerated opinion of mathematical formulas, aside from forming scientific dead baggage for many of those who study statistics, impedes the popularization of these very statistical methods, a popularization so much needed in all the countries of the world and especially in this continent. It is necessary to get rid of the popular notion that statistics is the science that teaches how to manipulate the figures collected, by means of highly complicated formulas, in order to obtain results little understandable and sometimes contradictory to common sense. We must show that by means of relatively simple methods it is possible to collect and analyze data which will be clear and easily understood by a man at the ordinary intellectual level and with no more than a general scientific preparation.

Let us pass from criticism to positive suggestions and see on what general principles a program of statistical instruction could be established in the countries of this continent.

V. Adequate programs of statistical training must incorporate among their aims the following:

a. To transmit statistical knowledge to a large number of persons in each country, not only to public employees, present and prospective, but also to private employees in commerce, industry, medicine, etc. To attain this end it is necessary to take a part of the statistical teaching out of the academic atmosphere of the university and to place it in secondary, professional, and special schools. The existing faculties with statistical programs could assist very effectively in this by establishing special courses in statistics outside the university.

b. To set up programs for these courses, and likewise for those of the university faculties, if possible, in such fashion as to permit a gradation in the subject matter and a differentiation or subdivision of the program. This differentiation will take two forms: (1) Vertical, and (2) horizontal.

1. Vertical differentiation: This term indicates that in the study of

statistics there are various stages of accomplishment, so arranged that the completion of each stage or grade permits the practical application of that which has been learned so far, in the professional work of the student.

2. Horizontal differentiation: This term refers simply to specialization in study in accordance with the practical field in which the student wishes to apply his statistical knowledge. The special fields might be, for example, economic statistics (with possible subdivisions, such as commerce, industry, agriculture, and banking), social statistics, public health, private industry (internal statistics of business), or statistics applied to the exact sciences (agronomy, medicine, chemistry, physics, etc.).

VI. Taking into account the fundamental principles set forth in the paragraph above, we may consider the following outline of a possible program for the study of statistics, or of the various branches of statistics. Perhaps it will not be out of place to stress the idea that the underlying motive in all statistical instruction should be, not to have the students memorize formulas and methods, but rather to stimulate in them, from the lowest grade to the highest, the spirit of independent thinking, of interest in the result of their work, and of eagerness for scientific investigation, all of which things are essential for the attainment of worth-while results in any statistical undertaking.

The program in its general aspects may be presented as follows:

1. Primary grade: Elementary algebra and arithmetic (equations). Simple averages (arithmetical). Proportions (percentages). Elements of compilation, filing, and public administration. Simple questionnaires. The construction of simple tables. Simple graphs. Special fields: Economic statistics; social statistics; public health; commercial and industrial. The operation of calculating machines.

2. Intermediate grade: Advanced algebra and arithmetic (quadratics). More complicated equations (with two or more unknown quantities). Logarithms. Geometric averages. Link relatives. Median and mode. More complicated tables and graphs. Simple index numbers. Complex filing systems (decimal index). Logarithmic curves. Regressions. Graphs in popular form. Operation of calculating machines. The slide rule. More extensive specialization.

3. Advanced grade: Financial and actuarial mathematics (calculus). Calculation of probabilities. Complete statistical methodology (errors, sampling, derivations, correlations, adjustment of variations, indexes of all kinds). Final analysis. Interpolation and extrapolation. Complex indexes. Complex graphs. Special fields: Economic and social statistics;

statistics of public health and medicine; statistics of the exact sciences; demographic statistics; internal statistics of business establishments; analysis of markets. Operation of machines using punched cards.

During the whole program the students would be required to do practical work (laboratory work) in considerable quantity based on actual cases. Publications and other statistical material would be discussed, analyzed, and evaluated.

The program outlined above constitutes only a brief summary presentation, far from complete. It would be essential to take advantage of experience in various countries and especially of that in Colombia under Professor Emilio C. Guthardt.[2]

It would be desirable for the American countries to adopt a program as far as possible standardized, especially for the teaching of their statistical employees, and more than anything else, for them to use standard technical terms in teaching and in publications and statistical reports, not only in English, but in Spanish, Portuguese, and French, for the different concepts and operations of statistics.

The profession of statistician should be rather clearly defined, recognized, and given certain privileges. For appointment to certain public positions, qualification in statistics, whether first, second, or third grade, should constitute an absolute prerequisite.

It may be said without exaggeration that certain skills in the field of statistics are now much more important than those in the field of accounting. If, then, the latter stand so high in many countries of this continent, why might there not be established a similar set of standards for statistics? There is no thought in this of creating a new class of certified public statisticians, but there is no doubt about the absolute necessity in all countries of having an appreciable number of persons trained in statistics, not only in public administration but also in private business. There seems to be no other way of attaining this end except through a wide extension of the teaching of statistics, not only through institutes or independent courses, but also through the inclusion of statistics in the program of commercial colleges and secondary schools in general as a required subject.

[2] See his article "Organization and Results of an Official Course in Statistics by Correspondence," in *Estadística*, Vol. I, No. 1, page 132.

ON SAMPLES FROM FINITE POPULATIONS

By Jerome Cornfield
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The following note is designed to illustrate a little-known device that has been found useful in the derivation of expected values and variances of statistics estimated from samples drawn from finite populations without replacement. Its only advantage is that it reduces the manipulations, which at best are tedious, to a simple algebraic routine. Its use is illustrated below in the derivation of the expected value of the sample mean and the variance of that mean.

THE EXPECTED VALUE OF A SAMPLE MEAN

Consider a parent population composed of N elements, with the mean for characteristic X defined as

$$\overline{X} = \frac{1}{N} \sum_{i=1}^{N} X_i. \tag{1}$$

The subscript i is to be considered as denoting a particular element in the population, so that X_i denotes the value for the ith element of the characteristic X. Thus X_i is a constant and not a sampling variate. Now denote the sample mean by

$$\overline{X}' = \frac{1}{n} \sum_{i=1}^{N} a_i X_i. \tag{2}$$

a_i is a variate which can assume one of two values. Its value is assigned after the sample is drawn. For any sample,

$a_i = 1$ if the ith element is included in the sample.

$= 0$ otherwise.

Since a_i is a sampling variate, while X_i is constant over successive samplings,

$$E\overline{X}' = \frac{1}{n} \sum_{i=1}^{N} X_i E a_i, \tag{3}$$

where E stands for expected value. By definition,

$$Ea_i = \text{Zero times (Prob. } a_i = 0) + \text{One times (Prob. } a_i = 1) \tag{4}$$

$$= (\text{Prob. } a_i = 1). \tag{5}$$

The probability that a_i is equal to one is the ratio of two quantities—

(A) the total number of samples which can be drawn in which

$a_i = 1$ (that is, the total number of samples which include the ith element).

(B) the total number of samples which can be drawn. In these $a_i = 1$ in some and 0 in others (that is, the total number of samples of size n which can be drawn whether or not they include the ith element).

The second quantity is obviously $\binom{N}{n}$. The first is seen to be $\binom{N-1}{n-1}$ by the following argument: We may enumerate all the samples of size n that include the ith element by

(a) removing it from the parent population, thus reducing its size to $N-1$

(b) drawing random samples of size $n-1$ without replacement from this reduced population

(c) adding the ith element to each sample so obtained.

The total number of different samples that can be obtained in step (b) is $\binom{N-1}{n-1}$, whereupon

$$(\text{Prob. } a_i = 1) = Ea_i = \binom{N-1}{n-1} \Big/ \binom{N}{n} = \frac{n}{N} \cdot \tag{6}$$

Substituting in (3) we obtain

$$E\overline{X}' = \frac{1}{N} \sum_{i=1}^{N} X_i = \overline{X}, \tag{7}$$

indicating that the sample mean is always an unbiased estimate of the population mean, a fact which is, of course, well known.

THE VARIANCE OF THE SAMPLE MEAN

The variance of the sample mean is defined as $E(\overline{X}')^2 - (E\overline{X}')^2$. It may be derived as follows:

$$\overline{X}' = \frac{1}{n} \sum_{i=1}^{N} a_i X_i \tag{8}$$

$$(\overline{X}')^2 = \frac{1}{n^2} \left[\sum_{i=1}^{N} a_i^2 X_i^2 + 2 \sum_{i=1}^{N} \sum_{j=i+1}^{N} a_i a_j X_i X_j \right] \tag{9}$$

and

$$E(\overline{X}')^2 = \frac{1}{n^2} \left[\sum_{i=1}^{N} X_i^2 E a_i^2 + 2 \sum_{i=1}^{N} \sum_{j=i+1}^{N} X_i X_j E a_i a_j \right] \tag{10}$$

$$Ea_i^r = Ea_i = n/N, \text{ for all } r > 0. \tag{11}$$

$Ea_i^r a_j^s$ $(i \neq j)$ may, by an argument similar to that used above, be shown to be equal to $\binom{N-2}{n-2}/\binom{N}{n}$ for all r and $s > 0$. In which case

$$Ea_i a_j = \frac{n}{N}\frac{n-1}{N-1}. \tag{12}$$

Equation (10) then gives

$$E(\overline{X}')^2 = \frac{1}{nN}\left[\sum_{i=1}^{N} X_i^2 + 2\frac{n-1}{N-1}\sum_{i<j} X_i X_j\right] \tag{13}$$

whereupon

$$E(\overline{X}')^2 - (E\overline{X}')^2 = \frac{1}{n}\frac{N-n}{N-1}\frac{\sum_{i=1}^{N} X_i^2 - N\overline{X}^2}{N}. \tag{14}$$

If we denote the variance of the parent population by σ^2, we have

$$E(\overline{X}')^2 - (E\overline{X}')^2 = \frac{\sigma^2}{n}\frac{N-n}{N-1}. \tag{15}$$

This result is also well known.

Simple extensions of the definition of the variate a_i make it possible to use it in considerably more complicated cases. Thus, in the case of sampling designs in which m clusters (counties, cities, blocks, etc.) are sampled from a population of M clusters, and n_i elements are sampled in the ith cluster from a population of N_i elements, we use one variate, a_{ij} which equals 1, when the jth element in the ith cluster is included in the sample, but is 0 otherwise; and another variate α_i which equals 1 when the ith cluster is included, but is 0 otherwise. In that case if

$$\overline{X} = \sum_{i=1}^{M}\sum_{j=1}^{N_i} X_{ij} \Big/ \sum_{i=1}^{M} N_i \tag{16}$$

and

$$\overline{X}' = \sum_{i=1}^{M} \alpha_i \frac{N_i}{n_i}\sum_{j=1}^{N_i} \alpha_{ij}X_{ij} \Big/ \sum_{i=1}^{M} \alpha_i N_i, \tag{17}$$

then the expected value and variance may be derived by noting that

$$Ea_{ij} = n_i/N_i \tag{18}$$

$$E\alpha_i = m/M \tag{19}$$

$$E\alpha_i a_{ij} = E\alpha_i E a_{ij} = \frac{m}{M}\frac{n_i}{N_i} \tag{20}$$

$$E\alpha_i\alpha_k = \frac{m}{M}\frac{m-1}{M-1}. \tag{21}$$

Equation (20) shows that when drawing m clusters from a population of M clusters, and then drawing n_i elements from the ith cluster (of size N_i), the probability of getting the jth element of the ith cluster in the sample is the product of two probabilities—viz., the probability of drawing the ith cluster and then independently drawing the jth element from it. Since the estimate $\overline{X}'$, defined by (17), is not in general an unbiased estimate of $\overline{X}$, as defined by (16), although in virtually all physical situations likely to be encountered in actual practice the bias will be negligible, the expected value and variance derived by use of equations (18)–(21) will be approximations rather than algebraic identities like (7) and (15).

A SIMPLIFIED FORMULA FOR MEAN DIFFERENCE

BY TSENG-TUNG CHENG
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SOME STATISTICIANS[1] have advocated the use of the quantity called "mean difference" in place of the commonly used mean deviation or standard deviation as a measure of the tendency of the spreading of a set of statistical data. The formula for this quantity as given in statistical books is rather long and not amenable to routine computation. By using a simple formula from the calculus of finite differences, a new relation for the computation of the sum of the differences between any two values of a set of N items when the latter are grouped into class intervals having the same length is obtained. By definition, this sum divided by the number of pairs of items in the set is their mean difference.

Let n = number of class intervals into which the set of N items is grouped;
s = length of each class interval;
f_k = frequency in the kth interval;
x_k = mid-value of the kth interval;
$F_i = \sum_{k=1}^{i} f_k$ = sum of the number of items in the first i class-intervals;
N = total number of items in all the intervals $= F_n$;
m = mean difference;
$C_2^N = \frac{1}{2}N(N-1)$ = number of combination of N things taken two at a time.

Then by definition,

$$C_2^N \times m = \sum_{i=2}^{n} \sum_{j=1}^{i-1} (x_i - x_j) f_i f_j = \sum_{i=2}^{n} \sum_{j=1}^{i-1} (i - j) s f_j f_i. \tag{1}$$

As is well-known in the calculus of finite differences,

$$\sum_{j=m}^{p} U_j V_j = U_{p+1} \sum_{j=m}^{p} V_j - \sum_{j=m}^{p} \Delta U_j \sum_{k=m}^{j} V_k, \tag{2}$$

Editor's Note.—This and the following paper have come by devious routes to the Journal office. The Editor has found it very interesting to realize that, after seven long years of war, statisticians in China can still make worthy contributions to statistical methodology.

It is regretted that most details of the story are missing. The following quotation from a letter can but whet one's appetitite. "His University fled from the Coast at the approach of the Japanese, but only a couple hundred miles west to Chanting which, in common with most parts of China a few miles from railroads and waterways, has never been in Japanese hands—though it has been bombed by them."

[1] Bowley, *Elements of Statistics*, p. 114.

where ΔU_j denotes the first difference of U_j, i.e. $U_{j+1}-U_j$. Now taking $U_j=i-j$, $V_j=f_j$, we find $U_i=0$, $\Delta U_j=-1$, and

$$\sum_{j=1}^{i-1}(i-j)f_j = U_i\sum_{j=1}^{i-1}f_j - \sum_{j=1}^{i-1}\Delta U_j \sum_{k=1}^{j} f_k = \sum_{j=1}^{i-1}\sum_{k=1}^{j} f_k = \sum_{j=1}^{i-1} F_j. \qquad (3)$$

By substitution, equation (1) becomes

$$C_2^N \times m = \sum_{i=2}^{n}\sum_{j=1}^{i-1} F_j f_i s. \qquad (4)$$

In (4), by interchanging the order of summation and remembering that the starting value for j is 1, that the final value for i is n, while i is greater than j by 1 at the least, we obtain

$$C_2^N \times m = \sum_{j=1}^{n-1}\sum_{i=j+1}^{n} f_i F_j s = \sum_{j=1}^{n-1}(F_n - F_j)F_j s$$

$$= \left(N\sum_{j=1}^{n-1} F_j - \sum_{j=1}^{n-1} F_j^2\right)s, \qquad (5)$$

whence

$$\text{the mean difference, } m = \frac{\left[N\sum_{j=1}^{n-1} F_j - \sum_{j=1}^{n-1} F_j^2\right]s}{C_2^N}. \qquad (6)$$

It should be pointed out that the quantity M^2 defined below as the mean of the squares of the differences between any two values of a set of N items bears a definite relation to the standard deviation of these N items as mentioned by Bowley.[2] This is readily shown algebraically as follows. Let

M^2 denote the mean square difference;
X_i and X_j, any two values in the set;
A, the arithmetic average; and
N, the total number of items in the set.

Then by definition

$$M^2 = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(X_i - X_j)^2}{N(N-1)} \qquad \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}(X_i - A + A - X_j)^2}{N(N-1)}$$

$$\frac{2N\sum_{i=1}^{N}(X_i - A)^2}{N(N-1)} \qquad (7)$$

[2] *Loc. cit.*, p. 115.

Now the standard deviation σ is defined by $N\sigma^2 = \sum_{i=1}^{N}(X_i - A)^2$, and so

$$M^2 = 2N\sigma^2/(N-1), \quad \text{or} \quad M = \sqrt{2N/(N-1)\sigma}. \tag{8}$$

On account of this relation it appears that whatever merit the quantity m called mean difference may possess is equally shared by the standard deviation σ or its analogue, the root mean square difference M.

In concluding the writer wishes to express his gratitude to President A.P.-T. Sah of the National Amoy University for valuable suggestions.

A NEW PROBABILITY FUNCTION AND ITS PROPERTIES

By Tseng-Tung Cheng
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Let $x_1, x_2, \cdots, x_n$ be n quantities which vary within the interval $(0, 1)$ and have the same probability function $\phi(x)$. Let $f(t)dt$ be the probability that the sum of these n quantities has a value between t and $t+dt$. Then

$$f(t) = \frac{d}{dt}\int\int\cdots\int_V \phi(x_1)\phi(x_2)\cdots\phi(x_n)dx_1dx_2\cdots dx_n, \tag{1}$$

where the region V, over which the n-tuple integral is extended, is defined by the inequalities

$$0 \leqq x_1 \leqq 1,\ 0 \leqq x_2 \leqq 1,\ \cdots,\ 0 \leqq x_n \leqq 1,\ x_1+x_2+\cdots+x_n \leqq t. \tag{2}$$

Let V' be the region defined by

$$0 \leqq x_1,\ 0 \leqq x_2,\ \cdots,\ 0 \leqq x_n,\ x_1 + x_2 + \cdots + x_n \leqq t,$$

and V_s be that part of V' in which s and only s of the x's are greater than 1, so that when $k < t \leqq k+1$, we may write symbolically

$$V' = V + V_1 + \cdots + V_k. \tag{3}$$

Again, let $V^{(s)}$ be the region defined by

$$x_1 \geqq 1,\ \cdots,\ x_s \geqq 1,\ x_{s+1} \geqq 0,\ \cdots,\ x_n \geqq 0,\ x_1+x_2+\cdots+x_n \leqq t \tag{4}$$

where, of course, s is less than t. Furthermore, we will denote the values of the n-tuple integral

$$\int\int\cdots\int \phi(x_1)\phi(x_2)\cdots\phi(x_n)dx_1dx_2\cdots dx_n$$

extended over the regions V, V', V_s and $V^{(s)}$ respectively[1] by I, I', I_s and $I^{(s)}$.

By the definitions given above, we may derive the following relations:

$$\left.\begin{aligned}
C_1^nI^{(1)} &= I_1 + C_1^2I_2 + C_1^3I_3 + \cdots + C_1^kI_k \\
C_2^nI^{(2)} &= \qquad\quad\ \ I_2 + C_2^3I_3 + \cdots + C_2^kI_k \\
C_3^nI^{(3)} &= \qquad\qquad\qquad\quad\ \ I_3 + \cdots + C_3^kI_k \\
& \\
C_k^nI^{(k)} &= \qquad\qquad\qquad\qquad\qquad\qquad I
\end{aligned}\right\} \tag{5}$$

[1] It is assumed here that the function $\phi(x)$ has also been defined for values of x lying outside the interval (0, 1).

where C_s^n denotes, as usual, the number of combinations of n things taken s at a time.

With the aid of the relation

$$I' = I + I_1 + \cdots + I_k,$$

which follows immediately from equation (3), we find from equations (5) that

$$I = I' - C_1^n I^{(1)} + C_2^n I^{(2)} - \cdots + (-1)^k C_k^n I^{(k)}. \tag{6}$$

The transformation

$$x_1 = z_1 + 1, \cdots, x_s = z_s + 1, x_{s+1} = z_{s+1}, \cdots, x_n = z_n \tag{7}$$

carries the region $V^{(s)}$ into a new region $R^{(s)}$ defined by the inequalities

$$z_1 \geqq 0, z_2 \geqq 0, \cdots, z_n \geqq 0, z_1 + z_2 + \cdots + z_n \leqq t - s. \tag{8}$$

Hence

$$I^{(s)} = \int\int \cdots \int_{R^{(s)}} \phi(z_1 + 1) \cdots \phi(z_s + 1)\phi(z_{s+1}) \cdots \phi(z_n) dz_1 dz_2 \cdots dz_n. \tag{9}$$

If $\phi(x)$ be a polynomial in x, then each of the integrals I' and $I^{(s)}$ is the sum of a number of Dirichlet's integrals, and may therefore be expressed in terms of Γ functions. In particular, when $\phi(x) \equiv 1$,

$$I' = \frac{[\Gamma(1)]^n}{\Gamma(n+1)} \cdot t^n = \frac{1}{n!} t^n, \tag{10}$$

$$I^{(s)} = \frac{1}{n!} (t - s)^n, \quad s = 1, 2, \cdots, k. \tag{11}$$

Substituting (10) and (11) into (6) gives

$$I = \frac{1}{n!} [t^n - C_1^n (t-1)^n + \cdots + (-1)^k C_k^n (t-k)^n], \quad k < t \leqq k+1. \tag{12}$$

Differentiating (12) we obtain finally

$$f(t) = \frac{dI}{dt} = \frac{1}{(n-1)!} [t^{n-1} - C_1^n (t-1)^{n-1} + \cdots + (-1)^k C_k^n (t-k)^{n-1}], \quad k < t \leqq k + 1. \tag{13}$$

As shown elsewhere,[2] the function $f(t)$ has the following properties:

[2] T. T. Cheng, Collected Scientific and Engineering Papers, National Amoy University.

(a) $f(t)$, together with its first $n-2$ derivatives, is continuous throughout the interval $(0, n)$.

(b) $f(t)$ is symmetric with respect to the point $t=\frac{1}{2}n$.

(c) $f(t)$ increases in the t-interval $(0, \frac{1}{2}n)$ and decreases in $(\frac{1}{2}n, n)$.

(d) The moments of $f(t)$ with respect to its arithmetic average $t=\frac{1}{2}n$ are given by the following identity:

$$\sum_{k=0}^{\infty} \frac{t^k}{k!}\mu_k = \left(\frac{e^t - 1}{te^{\frac{1}{2}t}}\right)^n, \tag{14}$$

where μ_k denotes the kth moment. Hence

$$\mu_0 = 1,\ \mu_1 = 0,\ \mu_2 = n/12,\ \mu_3 = 0,\ \mu_4 = (5n^2 - 2n)/240, \cdots . \tag{15}$$

In general, $\mu_{2k+1}=0$ and μ_{2k} is a polynomial of the kth degree in n which may be written in the form

$$\mu_{2k} \quad \frac{(2k!)}{k!}\left[\frac{1}{3!}\ \frac{1}{2^2}\right]^k n^k[1 + \text{terms involving } 1/n]. \tag{16}$$

Neglecting the terms involving $1/n$ and denoting the standard deviation by σ, this equation gives

$$\sigma^2 = \mu_2 = n/12, \tag{17}$$

whereupon it follows that

$$\mu_{2k} = (2k - 1)(2k - 3) \cdots 3.1\sigma^{2k}, \tag{18}$$

which is a property characteristic of the normal curve

$$y = \frac{1}{\sqrt{2\pi}\,\sigma} e^{-x^2/2\sigma^2}.$$

A CHART OF THE CHI-SQUARE DISTRIBUTION

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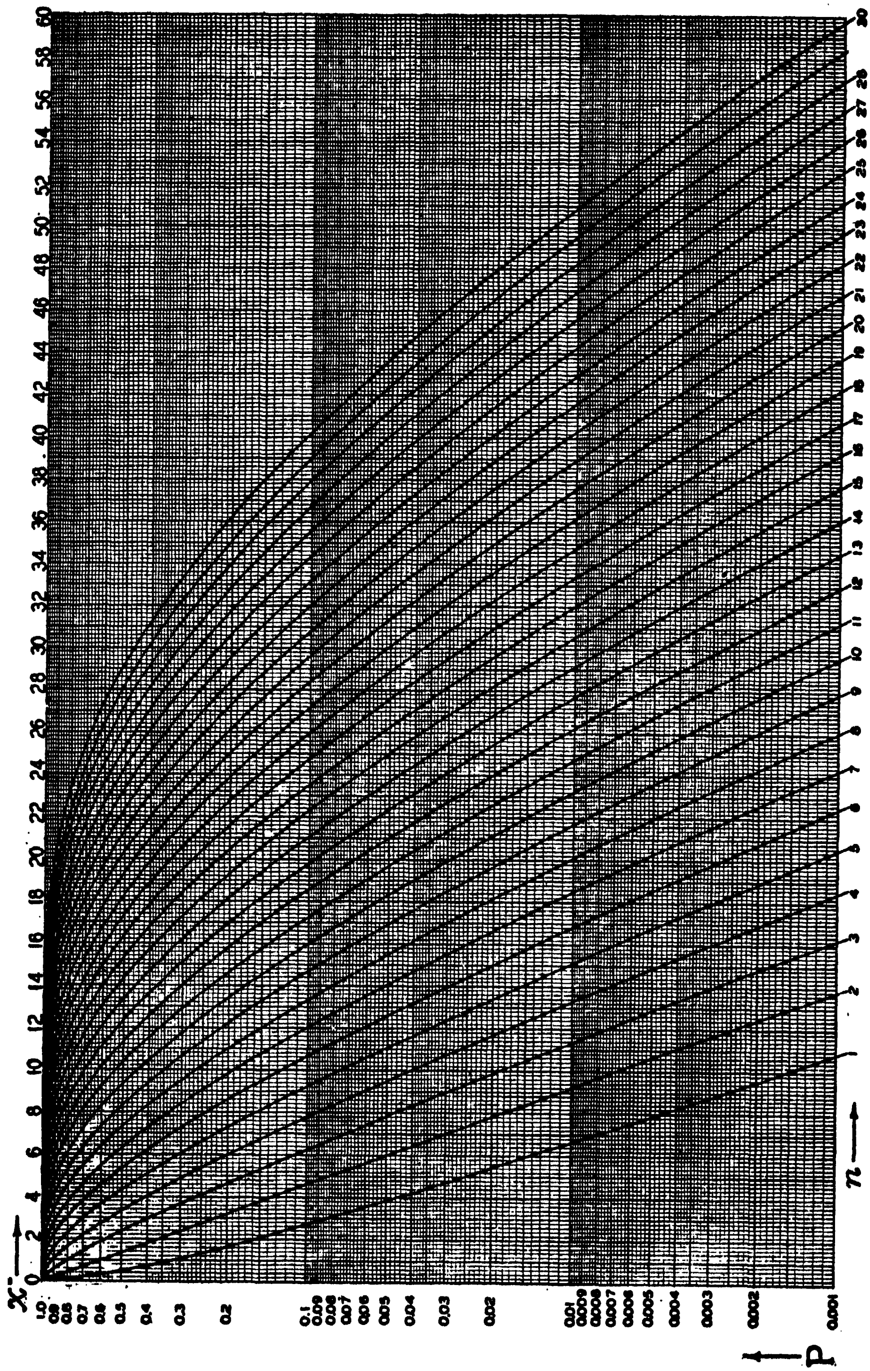
In reaching conclusions from data, the information provided by chi-square is often the most decisive single factor. Other information, however, may determine in any particular case the level of probability which the experimenter will accept as "significant," despite the general adoption of $P = 0.05$ as its numerical equivalent. Reporting the value of P corresponding to a given chi-square would facilitate the interpretation of a result. Most tables of the chi-square distribution require inverse interpolation of a non-linear function to obtain the value of P, which discourages its being reported more exactly. Alternatively, the distribution can be plotted on semi-logarithmic paper in a form allowing easy graphic interpolation of the probability. Since degrees of freedom (n) are discontinuous, a separate curve is drawn for each in the usual range from $n = 1$ to 30 giving continuous functions for χ^2 and P on the abscissa and ordinate respectively.

Such a chart for probabilities from $P = 0.01$ to 1.0 was prepared by the author in 1927 and photographed for use in laboratories of the Bureau of Entomology of the U. S. Department of Agriculture. It has since proved so valuable a time-saver in interpreting chi-square that the diagram has recently been redrawn to cover a wider range of probabilities, from $P = 0.001$ to 1.0. For this purpose points were plotted from three tables of chi-square, Table XII in Pearson's *Tables for Statisticians and Biometricians*, Part I (1924); Table IV in Fisher and Yates' *Statistical Tables for Biological, Agricultural and Medical Research* (1938) and the "Table of Percentage Points of the Chi-Square Distribution" by K. M. Thompson, *Biometrika*, 32: 187–191 (1941). Smooth curves were drawn through these points with an adjustable ruler, leading to the chart shown in reduced form in the accompanying figure. Values of P in the useful range can be interpolated from the original chart with an error not exceeding one or two digits in the second significant figure. Limited numbers of the full-size chart may be obtained without charge on application to the Department of Pharmacology of Yale University.

The use of the chart may be illustrated by an experiment in bioassay. Three digitalis-like drugs, isolated from two species of *Calotropis*, have been compared in parallel titration-tests with ouabain and with each



χ^2
P
n

other for their toxicity to cats (*J. Pharm. and Exptl. Ther.* 74, 223–234, 1942). Since the logarithms of the lethal doses are usually distributed normally, the drugs have been compared in terms of their geometric means as measures of the median lethal dose (LD50). Differences in size of cat were adjusted by dividing the fatal dose of drug per cat by the 2/3 power of its heart weight. Whether the doses killing 50 per cent of the cats were reliable indices of relative toxicity at lower or higher mortalities, such as 5 or 95 per cent, depends upon the equivalence in logarithmic units of the standard deviations of the four drugs.

In order of increasing LD50, the estimated standard deviations with 11 degrees of freedom were 0.0714, 0.0629, 0.1319 and 0.0842 for ouabain, calotropin, calotoxin and uscharin, respectively. Whether these were consistent with their pooled value of $s=0.0916$ $(n=44)$ has been examined by Bartlett's χ^2 test for the homogeneity of a series of variances (*J. Roy. Stat. Soc. Suppl.* 4, 137–170, 1937). The result was $\chi^2=7.28$ with 3 degrees of freedom (n). Referring to the curve for $n=3$ in the accompanying chart, we find that $P=0.063$ at $\chi^2=7.28$. The odds were 63 in 1000 that the differences observed in the standard deviation could have arisen by chance alone if the four drugs were characterized by the same standard deviation. Recomputing with ouabain omitted, $\chi^2=5.89$ from which the curve for $n=2$ gives $P=0.052$. This is just at the border line of significance and suggests that the three drugs from *Calotropis* may differ qualitatively in their action, in which case they would have different relative toxicities at doses killing 5 and 95 per cent.

Acknowledgment: I am indebted to my assistant, B. L. Bartels, for preparing the original of the present chart.

NOTES AND DISCUSSIONS

HENRY LEWIS RIETZ, 1875–1943

PROFESSOR HENRY LEWIS RIETZ, distinguished mathematician, statistician and actuary, died December 7, 1943, at 12:25 A.M. at University Hospital in Iowa City, Iowa, after a two year illness.

Professor Rietz was born in Gilmore, Ohio, August 24, 1875, the son of Jacob and Tabitha Jane Rietz. He received his B.S. degree from Ohio State University in 1899. During 1900–01 he was a Fellow at Cornell University. He was Assistant in mathematics at Cornell during 1901–02 and received the degree, Ph.D., from Cornell in 1902.

Professor Rietz was Professor of Mathematics and Astronomy at Butler during 1902–03; Instructor in Mathematics, 1903–04, Assistant Professor of Mathematics, 1904–11, Associate Professor of Mathematics, 1911–13, and Professor of Mathematics, 1913–18, at the University of Illinois. He came to the University of Iowa in 1918 as Professor of Mathematics and Head of the Department of Mathematics. Under his leadership, the department became an outstanding school in the fields of Statistics and Actuarial Theory. Many of his students hold prominent positions in the statistical and actuarial world. He continued to serve as department head with outstanding success until his retirement from the position in September, 1943. He was in charge of the Statistical Experiment Station, University of Illinois, 1907–18. In 1916 and in 1918, he served as a member and consulting actuary for the Illinois Pension Laws Commission. He was actuarial consultant, Federal Emergency Relief Administration, in 1934–35. He served as a Trustee of the Teachers Insurance and Annuity Association in 1934.

Professor Rietz was a Fellow of the American Association for the Advancement of Science (vice-president in 1929), a member of the American Mathematical Society (vice-president in 1930), Associate Editor of *Bulletin of the American Mathematical Society*. He was a member of the Mathematical Association of America (president in 1934), a Fellow of Institute of Actuaries (vice-president in 1919), a member of the American Statistical Association (vice-president in 1925), a Fellow of the Institute of Mathematical Statistics (president in 1935–37), a member of the Iowa Academy of Sciences (president in 1930), a Fellow of the Royal Statistical Society, and Associate Editor of the *Transactions of the American Mathematical Society* in 1937.

He was a member of A.T.O. social fraternity, Sigma Xi honorary scientific fraternity, Phi Beta Kappa national scholastic society and Gamma Alpha honorary graduate scientific fraternity.

Professor Rietz was the founder of the Institute of Mathematical Statistics. In March, 1943, the Board of Directors of the Institute dedicated the 1943 volume of its official *Annals* to him on the occasion of his retirement after twenty-five years of service and "in recognition of his contributions to the initiation and development of mathematical statistics in America." This was the first time the official *Annals* has been so dedicated.

He was the principal author of college text books in Algebra, Trigonometry, and Mathematics of Finance. He was the principal author and Editor-in-Chief of the *Handbook of Mathematical Statistics* and was the author of *Mathematical Statistics* (Carus Monograph #3). In addition, he has published at least 150 significant articles in mathematics, statistics and actuarial theory in various journals.

In 1939, the Iowa Mathematical Alumni Association had a portrait of Professor Rietz made and presented it to the University in the spring of 1940. This portrait has been placed in the Mathematics and Physics library in the Physics Building. The Alumni also presented him with a watch in appreciation of the training they received from him.

Professor Rietz was very active in local affairs: he was a member of the official board and chairman of the finance committee of the Methodist Church for more than 20 years. For more than 15 years he was chairman of the finance committee of the Iowa City Country Club and was its President for two years. In June 1919, he became a charter member of the Iowa City Building and Loan Association and has been President since June 1920. He was a member of the Board of Directors of the First Capitol State Bank and a member and former President of the Kiwanis Club.

Surviving him are a brother, Professor John Rietz, Morgantown, West Virginia, and a sister, Mrs. F. S. Taylor, Caldwell, New Jersey.

Professor Rietz was a Christian gentleman, a great scholar and researcher, and an excellent teacher. He was the concrete expression of honesty and had a frankness that was both most pleasing and refreshing. He had a keen intellect, an alert analytical mind and was a man with whom honor was sacred. Because of his character and ability, his advice and judgment were much sought when, and only when, a cause was honest and just. He loved the game of golf for recreation. He was an excellent companion and had a sense of humor that made him many friends who are scattered far and wide throughout the country. All his friends delighted in his companionship. He was very generous and never failed in his efforts to advance deserving friends, students, and associates and he was very devoted to his friends and relatives.

He enjoyed life and lived a full life whether it was doing serious work or during times of relaxation. He was in every sense the ideal one would seek in research and teaching. He considered research essential in teaching, but it was teaching itself that gave him the most pleasure. He was the kind of man which makes any university great.

I have known Professor Rietz for 25 years. I have known him as a colleague, a department head, a teacher, and a companion. He was much closer than a true friend and companion to me. He was my best friend and my best teacher. We have all lost a great scholar, a great teacher and man.

FRANK MARK WEIDA

ARNE FISHER, 1887–1944

ARNE FISHER—Mathematician and Philosopher—passed away April 7, 1944, at the relatively young age of fifty-seven. A scholar in every sense of the word, Fisher's comments on any subject were always enlightening, significant and, salted with a humorous touch peculiarly his own, most entertaining.

Regarding Fisher's contributions in the field of statistics and probability theory, work on war problems prevents the writer from devoting to them the time required for an adequate discussion. Moreover, an intimate friendship of over a quarter of a century makes it difficult for him to take, at this time, a detached attitude toward Fisher's work. However, in anticipation of a later review either by himself or by some more competent person, it may be stated here that Fisher's greatest contribution was calling to the attention of American mathematicians the works of the great Scandinavian statisticians. Gram, Thiele, Westergaard, Charlier, were mere names to us before the publication of Fisher's *The Mathematical Theory of Probabilities* in 1922.

Arne Fisher was born in Randers, Denmark, and came to the United States in 1902. At the time of his death he had been for twenty-four years actuary of the Western Union Telegraph Company, where his work was chiefly concerned with business forecasting and with the Company's employe pension plan. Before joining the Telegraph Company he had been with the Prudential Insurance Company. He was a Fellow of the American Statistical Association and of the Association of Swiss Actuaries and a member of the Royal Danish Actuarial Society.

EDWARD C. MOLINA

A REPLY TO W. EDWARDS DEMING'S REVIEW OF *TREATMENT OF EXPERIMENTAL DATA*

By A. G. Worthing
University of Pittsburgh

A BOOK REVIEWER has a responsibility both to the author and to the reading public, particularly that public, normally indicated in the preface, for which the book is intended. Many reviews, as Mr. Deming has said, are "written by some one who sits down and hands out bouquets without cracking the book" or at least approximately that. Such reviews are practically useless.

The question arises, what should a review include? Without doubt others will differ with the writer, but in his opinion, certain principles will be conceded generally. In addition to the normal introductory matter, a book review should indicate, (1) except where obvious, the fields covered in a somewhat, but not too, detailed way, (2) the public for whom the book is intended, (3) criticisms, favorable and unfavorable, of the need of the book, of procedures followed, of material included or left out, of the precision or lack of precision encountered, of the English used, and of such other material as will enable a busy potential user to conclude that the book is probably worth or not worth his while. The public for whom the book is intended should be continually kept in mind. It is perfectly proper for a reviewer to "pan" an author for lack of purpose, faulty procedures, looseness of thought, failure to include appropriate material, failure to exclude inappropriate material and many other things. Such panning should be done justly, however, for the author ordinarily has but little opportunity for a comeback.

In addition to a few commendatory remarks, your reviewer[1] of *Treatment of Experimental Data*[2] has properly called attention to certain failures to include appropriate matter, has pointed out certain inaccuracies of statement, has listed certain original authors that were not mentioned, and has indicated that certain procedures which the authors have followed are unsatisfactory. These criticisms we appreciate and shall make use of them in case the public for whom the book is intended find the book so useful that a revision is justified. However, there are certain criticisms to which we make objection on the basis that they do not conform to the principles which we believe should govern the writing of a book review. Certain of these I discuss here.

The reviewer has not indicated the public for whom the book is in-

[1] This JOURNAL, March 1944, pp. 119–122.
[2] *Treatment of Experimental Data*, by A. G. Worthing and Joseph Geffner, 1943, John Wiley and Sons, Inc., New York.

tended, though the authors state in the preface, "This book has been written with the physicist, the chemist and the engineer in mind . . . considerable effort has been made to keep physical situations in mind throughout." Moreover, reading between the lines, it seems to the writer that the reviewer really reviewed from the standpoint of highly trained mathematicians rather than from the standpoint of those who are moderately trained in mathematics. Definitely our public was the latter group.

In discussing the section entitled "change of weights implied by a change of variables," Dr. Deming built up the impression that the authors were muddled regarding the effects of such changes of variables on the least-squares determinations of constants. He quotes one sentence from the section which by itself gives the impression that there are several least-squares determinations for a given constant. However, taken with the material which follows immediately that impression is shown to be wrong. Of course, the authors should have added the introductory phrase, "Disregarding weights." The ideal of making each sentence stand by itself is fine. I like it, but, I fear, I fail in living up to it. Incidentally, it is about as heinous to hold up, as expressive of an author's views, a single sentence which apparently differs from its context. Further, the very title to the section under discussion, as quoted above, shows that the authors were not muddled. Incidentally with regard to the alleged failure to take our own advice on page 248, I am of the opinion that the judgment given was too hasty. What we said may be badly worded, but it seems to be correct.

We cannot follow the reviewer in his criticism of the section relating to "The least-squares Equation of the Type $y=a+bx$ when Liability of errors occurs with both x and y." We say "Since x and y will generally differ in physical nature, it is necessary to treat certain simple functions of these variables rather than x and y themselves. These functions must be either dimensionless or expressible in the same physical units. Otherwise there seems to be no logical way of properly weighting them." As a physicist who thinks of x and y as representing *physical quantities* and not *numbers*, I feel that the procedure is justifiable and that no other *fundamentally different* procedure is possible. Moreover, we have not indicated nor felt that "There is no way out in more complicated situations." As to procedure here, which is thought not to be straightforward, the reference to an imaginary plot showing $Y'=f(x')$, would possibly not appeal to a true mathematician, but I must say that it helps greatly with the people for whom we write.

The reviewer says, "The greatest fault is lack of purpose. Why does

one wish to fit a curve in the first place? What is he going to do with it when he gets through? Why does one adjust the angles of a triangle? What is the purpose of adjustment? Why does one take data? Why does one wish to present data? As a guide in framing a course of action, of course, or for predicting the result of a future experiment, but one can search the book in vain for the answer." I think that physicists, chemists, and engineers would all have answered these questions for themselves long before they would open the book. However, we seem actually to have very definitely answered the first four questions asked in the introductions to the various chapters. Although the fifth and sixth questions have not been answered directly, it seems as though the reviewer might have seen, as a purpose throughout, a desire to give to certain groups of scientific workers satisfactory methods for treating their data so that such data may be presented in good form and so that they themselves and those to whom their conclusions may be presented may know to some extent their reliabilities. While this may not seem like the predicting of the result of a future experiment, it is not far from giving thought to the framing of a course of action.

NOTE TO "A MECHANICAL DETERMINATION OF CORRELATION COEFFICIENTS AND STANDARD DEVIATIONS"*

The author's attention has been called to the omission from the above article of mention of the paper by Bronson Price, in *Science*, November 22, 1935, Vol. 82, No. 2134, pp. 497–8. This paper discusses the theoretical possibility of constructing a device almost identical in principle but somewhat different in design from the one actually used by the author.

JOHN R. PLATT

Physics Department,
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* This JOURNAL, September 1943, Vol. 38, pp. 311–318.

BOOK REVIEWS

GLENN E. MCLAUGHLIN, *Review Editor*

Estimates of Future Population of the United States, 1940–2000, by Warren S. Thompson and P. K. Whelpton. National Resources Planning Board. Washington: U. S. Government Printing Office. 1943. 137 pp. 35 cents.

This set of estimates of the future population of the United States is the third which W. S. Thompson and P. K. Whelpton, of the Scripps Foundation for Research in Population Problems, have prepared for the late National Resources Planning Board. In 1934 *Estimates of Future Populations by States* appeared; in 1937, *Population Statistics, 1, National Data*, some materials from which were included in *The Problems of a Changing Population* (1938). New circumstances made desirable a revision of the 1937 estimates.

> Quite apart from the war, certain changes have been taking place to alter the outlook for population in the United States. Among the new factors that are affecting the future size and composition of the population are the continuance through 1942 of the upward turn of the birth rate that began in the middle 1930's, the introduction of the new chemotherapy with its promise of further reduction in mortality, the relatively favorable course of Negro mortality in recent years, the progressively greater concentration of childbearing in the earlier years of marriage, and considerable advances in the science of nutrition (p. 3).

The new estimates, twelve in number, are more comprehensive than those published for other countries. The several estimates are based, as were those in the 1937 study, on varying assumptions and combinations of assumptions regarding future mortality, fertility, and immigration. These estimates do not allow for the prospective effects (military deaths, fewer births) of war; but estimated probable deductions attributable to the present war are separately classified and tabulated for years for which population estimates are reported. The population estimates, by sex and five year age groups, are given at five year intervals, 1940–2000, for native whites, foreign-born whites, and colored. Corrected and uncorrected figures are given for children under five years of age.

The new estimates run considerably higher than those reported by the authors in 1937, and they carry the population maxima farther into the future. For example, the new high fertility estimate, conjoined with medium mortality and no immigration, yields 174.4 million for 1980 in contrast with 167.9 million in the 1937 estimate; it yields 190.7 million for 2000 at which time the population, on these assumptions, will still be growing. The corresponding medium fertility estimate yields 160.9 million in 1980 in place of the 1937 estimate of 153; it gives a population maximum of 161.4 as of 1985. The corresponding low fertility estimate as of 1980 is 148.7 in place of the earlier 134; it yields a maximum of 150.5 as of 1970 in place of the former lower maximum as of 1960.

This new study contains much invaluable material. Applied population study cannot be carried on without such estimates. It is to be hoped that these estimates will be revised if and when circumstances make such revision desirable, and that provision will be made for the publication of such revised estimates.

JOSEPH J. SPENGLER

Duke University

The American-Born in Canada, by R. H. Coats and M. C. Maclean. Toronto: The Ryerson Press, New Haven: Yale University Press; London: Humphrey Milford: Oxford University Press. 1943. xviii, 176 pp. $3.75.

The Canadian-Born in the United States, by Leon E. Truesdell. Toronto: The Ryerson Press; New Haven: Yale University Press; London: Humphrey Milford: Oxford University Press. 1943. xvi, 263 pp. $3.00.

For at least a hundred years there has been a substantial interchange of population between Canada and the United States. The movement from Canada to the United States has been larger absolutely than the movement in the other direction and has been strikingly large relative to the Canadian population. During the 'eighties, for every thousand added to the native-born population of Canada, 717 Canadians were added to the population of the United States. In 1930 there were 1,286,389 Canadian-born resident in the United States, while in 1931 there were 344,574 American-born resident in Canada.

These volumes, which form part of the series on the relations of Canada and the United States sponsored by the Carnegie Endowment for International Peace, undertake to describe the characteristics of these two population-groups as fully as the census statistics of the two countries permit. The chapter headings follow traditional census classifications: age, sex, rural or urban residence, conjugal condition, racial origin, occupation and the like. The presentation is designed for those who can live on a diet of statistical detail. The tabulations, of which there are almost 200 in the two volumes, carry the burden of the story, and the text merely re-states and underlines salient features of the tables. The volumes will clearly remain as the definitive compilations of statistical material on the subject for the years preceding 1931. Data from the most recent Canadian and United States censuses were apparently not yet available when the manuscripts went to press.

This is not the sort of study which lends itself readily to summarization, since its essence is detail. As one would perhaps expect, the Canadian-born in the United States show an occupational distribution very similar to that of the total population and are in most other respects closely similar to the native-born. The American-born population of Canada is also in most respects highly similar to the native-born population; its occupational distribution deviates little from that of the total population except for a somewhat greater concentration in agriculture and in managerial occupations and a

lower concentration in common labor. Thus from an occupational standpoint the interchange of population shows no marked pattern. Both groups have proven highly assimilable, have acquired citizenship in their chosen country relatively quickly, and have intermarried freely with the native-born population.

An interesting contrast appears in the geographical distribution of the two groups within the country of immigration. The American-born are found in every county of Canada and show a more even distribution relative to the total population than almost any other immigrant group. The Canadians in the United States, on the other hand, show a marked tendency to *bloc* in a limited number of areas. Three states—Massachusetts, New York and Michigan—contain half the Canadian-born, and the tendency toward geographic concentration extends downward to individual cities and even individual wards of cities. Canadians have tended to go where other Canadians have preceded them, while the movement of Americans has been markedly individualistic.

Dr. Coats, in an ingenious and brilliantly-written essay which forms Part I of his volume, has attempted to find reasons for the remarkably even diffusion of the American-born throughout Canada. He finds the explanation mainly in the relatively long period of time during which the American-born of 1931 had resided in Canada, the variety of racial strains among American-born immigrants and the tendency of each to seek out its like in Canada, and the substantial backflow to Canada of children born to Canadians resident in the United States. He is careful to point out, however, that each of these "causes" is actually a combination of several causes which need to be distinguished and some of which work in opposite directions.

LLOYD G. REYNOLDS

Johns Hopkins University

Canada's Jews, A Social and Economic Study of the Jews in Canada, by Louis Rosenberg. Montreal: Canadian Jewish Congress, Bureau of Social and Economic Research. 1939. xxix, 418 pp.

There is hardly in the English-speaking world a study comparable to this comprehensive investigation of Rosenberg's on Canada's Jews. Everyone who is interested in population studies in general and in studies of the Jewish minority in particular will appreciate this careful and detailed research. The reason—apart from the author's own interest—that such a study was possible in Canada, is the fact that in the population statistics of this Dominion the item of religious affiliation is officially covered in the census questionnaire. This is not the case in Great Britain nor in the United States. Therefore in both the latter countries the reported number of living Jews and all further subdivisions by age, sex, place of birth, civil status, occupation, etc., will always depend on estimates or sample studies more or less reliable for the total.

The last enumeration of the Jews in Canada, census of 1931, yielded a number of 156,726; the author's estimate for 1936 was 166,710. This means an increase of more than 900 per cent over the corresponding population in 1901, of 16,131, or within a period of 35 years the Jewish population of Canada has multiplied ten times. This percentage increase, according to the author, is higher than in any other country with a Jewish minority, even in Palestine and Argentine. A great wealth of differentiated tables is given in the text and the statistical appendix, showing the distribution of the Jews throughout the country by provinces and larger cities, the rural and urban distribution by size of places, the age and sex distribution, conjugal condition, and many more items, mostly in comparison with other ethnic groups of the Canadian population. The occupational and economic structure of the Jews has been dealt with in great detail, by social position and by economic divisions and subdivisions (agriculture, industry, trade, free professions, domestic service, etc.). Some comparisons are added for Jewish minorities in other countries, quoted mostly after Arthur Ruppin's work, *The Jews in the Modern World.*

The figures for Canada worked out meticulously by Rosenberg speak their own language even if one does not always follow the conclusions of the author which, however, are mostly objective and non-polemic in the much discussed problem of occupational "abnormalities" of the Jews. The population movement, natality and mortality statistics for the years, 1926–36, comparative immigration of different ethnic groups to Canada and Jewish immigration in particular, since the turn of the century, are covered by a series of chapters and tabulations. It may be worth mentioning that for the Jews the sex ratio at birth exceeded significantly this ratio for the total Canadian population; 1230 Jewish boys were born to 1000 Jewish girls, in the average of 1926–36, as compared to the sex ratio of 1055 for the total population of Canada. Causes of death are not covered in Rosenberg's study, and therefore a comparison with the total population is not yet possible. But the exact population figures by age and sex, and even by occupation among the gainfully occupied persons, offer an excellent basis for further socio-biological and socio-pathological studies. Detailed statistics are further given on intermarriage among persons of different religious faith, on education, criminality, and some morbidity features (deafmutism, blindness, insanity). It is impossible here to go into more details of the invaluable source material which comprises 273 tables in text and annex. It may serve as an example of what can be achieved when census results are available concerning the Jewish faith as well as other religious denominations.

In a concluding chapter the author enters the question of anti-Semitism which already was occasionally touched upon in the preceding chapters. This question, of course, involving religious and racial prejudice cannot be exhausted by statistical evaluations only. Many imponderabilia and many other items come in, psychological, historical, political elements, and last but not least religious-ritual customs which in the case of the Jews, owing to

marriage laws, have led to greater inbreeding than in any other racial group. All this can hardly be appraised by statistics alone, and nothing is changed by substituting the term "ethnic" groups for "racial" groups as the author suggests. Yet a source work like that of Rosenberg's is the best and most reliable fundament for further discussions and should be emulated in other countries to clear the situation. Better knowledge of the basic facts will never produce—nor prevent—anti-Semitism which is essentially an emotional phenomenon not conquerable by logic and reason.

The only comparable source material that exists as far as this reviewer knows, is the equally monumental work of Heinrich Silbergleit (the late statistician and erstwhile director of the Statistical Bureau of the city of Berlin, prior to Hitler's rise to power): *Die Bevölkerungs- und Berufsverhältnisse der Juden im Deutschen Reich*, Berlin, Akademie-Verlag, 1930. Unfortunately, this source work in the German language has not been quoted by the author or listed in his bibliography, the only technical criticism worth mentioning.

GEORGE WOLFF

Glen Echo, Maryland

Handbook of Tabular Presentation, by Ray Ovid Hall. New York: The Ronald Press Company. 1943. viii, 112 pp. $3.50.

For many years there has been an outstanding need for an adequate handbook of tabular presentation. Dr. Hall's book is in the first place too short for adequate coverage of the field, with only 13 pages of general text and 25 or 30 more devoted to the discussion of specific examples. In other respects, too, it falls short of meeting the current need—or the expectations aroused by its title page. It contains rather frequent recommendations of procedures that run counter to current usage. For example, Dr. Hall recommends the use of a parallel line at the bottom of the box head of the table, whereas current usage calls either for a parallel line at the top or for no parallel line at all. Again, he recommends that a title number should be separated from the title immediately following by a colon, whereas the almost universal practice is to use a period and a dash.

In a number of instances the author is apparently under a misapprehension on points of fact, as for example, in the statement that the table titles in the *Statistical Abstract* are printed in caps, whereas in recent issues of the Abstract the titles are printed entirely in caps and small caps, and even in the older issues the titles were only partly in caps. He insists or implies that every table should have a headnote, whereas it will be generally agreed that, with a few exceptions based on the nature of the material rather than on the form of the table, a good statistical table should be adequately intelligible without any headnote. He accepts, and designates as "census style," the placing of total lines at the top of a table or section rather than at the bottom, but ignores (without even mentión as an alternative) an equally important feature of census style, namely, the placing of the most recent

date at the left, close to the stub, in a table presenting columns of data for various years.

The supplementary material is not well arranged or adequately labeled. The changes recommended in the comment on the specimen tables are for the most part improvements, though in some cases they result in presentations quite as illogical as anything in the original table; for example, in the revised stub on pages 52 and 53 the items "A: Total (payable in dollars):" and "B: Total (payable in foreign currencies):" violate several criteria that might be set up, in particular in that the distinguishing element between the two groups is not only put second in position but also placed in parentheses—as no essential part of a designation should ever be.

Throughout, the book mingles specifications for the physical make-up of tables that are to be printed in type and tables to be written on the typewriter for photographic reproduction, whereas one of the first requirements in a set of instructions for this phase of table-making should be a recognition of the fact that two distinct sets of techniques are required for these two methods of printing.

With the exception of a brief generalized preface, the book is confined mainly to statements on specific mechanical points. It is unfortunate that the author did not see fit to devote more time to an opening discussion which would bring the materials into better perspective. In its present form the book reads like a series of items from a notebook carefully kept but not well coordinated, or like a book of exercises designed to test the mastery of a comprehensive volume which unfortunately is not existent. It is replete with sententious phrases, some of which one cannot but admire even though he does not always agree with the import. In short, it may be said of the whole book that, while it is interesting to read and stimulating to one already familiar with current usage in the construction of statistical tables, and while many—yes, even most—of the recommendations with respect to table form are good, there are so many variations from this rule that the book cannot safely be taken as a reliable guide for the inexperienced maker or editor of statistical tables.

LEON E. TRUESDELL

Bureau of the Census

Elementary Statistical Methods, as Applied to Business and Economic Data, by W. A. Neiswanger. New York: The Macmillan Company. 1943. xviii, 740 pp. $4.00.

It is the stated purpose of this volume to serve as a text for a one-semester course in statistics for students of economics and business. The lengthy and wordy approach to the subject involving more than 700 pages of text makes questionable the use of the volume for a one-semester course.

The author's intention was to "emphasize the basic concepts of statistical methods so that certain principles will endure long after details have been

forgotten." While this objective is entirely worthy, especially for courses in which it is intended merely to introduce students to the subject, the resulting emphasis upon broad generalizations may readily defeat the aim by the very vagueness of the generalizations. For instance, the first chapter indicating illustrative uses of statistical analyses in which an attempt is made to describe in a paragraph or two a broad application of statistics, is likely to be misleading. As an example the attempt to describe the War Department supply control statistical procedures in less than one page of text is of doubtful value and not likely to be enlightening in understanding the application of statistical methods to this broad problem.

The treatment of subjects such as the steps in conducting a statistical investigation, the preparation of questionnaires, and graphic presentation is not well organized or systematic.

As might be expected in a volume of this type there is considerable emphasis upon index numbers and methods of their construction and time series analysis. The exposition of these subjects is adequate and the approach systematic. The examination of a considerable number of current index number series lends interest and gives rise to a better understanding of some of the problems of index number construction.

The scope of the volume is usual for the texts of this type, the differences being largely matters of emphasis. The illustrative computations are typical of the application of statistical techniques to broad economic problems rather than problems relating to the individual business enterprise.

The volume is written clearly and lucidly, and since the instructor in a course of the type for which it is intended is at liberty to leave out of the directed readings much of the non-essential materials and can change the emphasis at will, the book will serve as an adequate text when judiciously applied.

HERBERT ARKIN

College of City of New York
(On leave to U. S. Army)

Elements of Statistical Method, by Albert E. Waugh. New York and London: McGraw-Hill Book Company, Inc. Second Edition. 1943. xxi, 532 pp. $4.00.

This volume is a revision of a book which was first published in 1938. The basic arrangement of the first edition has been maintained in the new edition, but there has been some reorganization and expansion which has resulted in the addition of four new chapters.

The aim of the book, as stated by the author, is to introduce the student to statistical concepts and statistical nomenclature and to get him to think in statistical terms. The book is not planned for the statistician in any particular field. It is also the author's purpose to make clear from time to time that one cannot safely apply statistical methods in any field unless and until he has become a master of that field.

After a short introductory chapter, the book immediately proceeds with the more mathematical approach to the methods of statistics, and covers the more elementary aspects of the meaning of numbers, frequency distributions, measures of central tendency, measures of dispersion, probability, the normal curve, moments, measures of skewness and kurtosis, the Poisson Series, the chi-square test, measures of reliability, secular trend, cyclical movements, index numbers, and linear, curvilinear, and multiple correlation. The main part of the book then closes with two short chapters on tabulation and graphic presentation, and collection and analysis of data. Selected statistical tables and a short bibliography are included in the appendices. Reading suggestions and exercises are included at the ends of the chapters.

While the book is designed to be elementary, the author assumes a good knowledge of college algebra on the part of the reader. In many instances, however, the discussion of methods involves concepts or procedures not ordinarily covered in college algebra.

This book presents an excellent selection, as well as an excellent description, of methods that should be considered by the beginner in statistics. No two teachers naturally will agree upon exactly how a course in statistics should be taught or how a text book should be written. And the problem is more difficult if the course is a general one for students majoring in a number of fields than it is if the course is designed for students in a single specialized field. The outstanding difficulty arises, of course, in explaining the application of the various methods. In the limited time that can be devoted to the study of a certain method, the student often does not grasp its significance thoroughly enough, when applied to a field not his own, to enable him to carry its use over to his own field. The present text, designed as it is to cover a broad field, generously illustrates the methods with examples from many kinds of activities, but it wisely refrains from assuming too much responsibility for teaching intensive application and leaves it to the instructor to coordinate the problems of application with the various interests of his class. The teacher of a general course, therefore, who himself can cover application in his lectures and laboratory work and will also augment the information on tabulation and collection of data, should find this book to be a very satisfactory text for covering the description of methods in elementary statistics.

JOHN R. RIGGLEMAN

Washington, D. C.

Hospitalized Illness in New York City, by Neva R. Deardorff and Marta Fraenkel. New York: Welfare Council of New York City. Hospital Discharge Study, Volume 2. 1943. xvii, 349 pp. $1.00.

This is the second of a series of three volumes which analyze 576,623 discharges from hospitals in New York City in 1933. The study was made by the Research Bureau of the Welfare Council of New York City with the assistance of the state and city work relief authorities and the Works Projects Administration. Volume I, *Hospitals and Hospital Patients in New York City*,

dealt with the general demographic and public health aspects of the study; this volume deals with its medical aspects. Volume III "will extract from the experience of the project practicable ways and means for hospital morbidity reporting as a routine procedure."

The present volume is divided in the main in three sections: obstetrical service (of the total of over a half-million discharges, 23 per cent were of obstetrical patients and newborn); service for acute conditions; and service for chronic conditions. Separate chapters are devoted to the more important specific conditions; and in each, hospitalization for these causes is discussed in relation to a variety of pertinent factors, race, age, and sex of patients, length of stay, type of hospital, and so on. Brief chapters at the end are devoted to convalescent homes and homes for the chronically ill. An appendix section deals with problems peculiar to hospitalization of children and of the aged. There are 108 brief tables and an extremely important extended table showing for each of the general voluntary and municipal hospitals in the study the number and per cent of discharged patients for selected diagnoses.

The data, despite the fact that they are ten years old and that recent medical discoveries may seriously affect hospitalization habits, are of great value. Information on age and sex differences in hospital rates for the different diseases are important to any well planned community program of hospital construction and maintenance. The data show wide differences among hospitals in the proportion of cases of various conditions, a fact which may mitigate against rounded training of interns. They point up the need among hospitals to make uniform the terminology and classification of disease. The data are also useful in that they add confirmation to the findings of other studies, and to commonly held beliefs—for example, that care for many of the patients was necessarily of a custodial character and that care in more appropriate institutions will often serve the patient at least as well as the hospital does and probably at less cost to the community.

The text is very readable, which is unusual in a work of this nature. That the manuscript had to be printed by the offset process, because of "the financial strain on voluntary agencies during these times," will not detract from its usefulness to all persons interested in the hospital field.

Isidore Altman

U. S. Public Health Service

Union Rights and Union Duties, by Joel Seidman. New York: Harcourt, Brace and Co. 1943. viii, 238 pp. $2.50.

The growth of union power during the past decade has inevitably raised the question of union responsibility. This book, written from a point of view sympathetic with labor, acknowledges that some unions are guilty of irresponsible and anti-social acts and warns organized labor to put its house in order.

The alternative is government regulation, which, if drastic and ill-designed,

may permanently impair the labor movement. As an example of the extreme measures that may be taken, the author cites the Smith bill, passed by the House of Representatives shortly before the attack on Pearl Harbor. Rather surprisingly, he fails to discuss the restrictive features of the Smith-Connally Act, passed over the President's veto in June 1942.

Some of the abuses of power discussed in this book have been harmful primarily to the unions' own membership or the labor force from which that membership is drawn. These include the denial of union cards to Negroes and certain other groups, excessive entrance fees and dues, undemocratic administration, and financial irresponsibility. Among the chief offenses against employers are strikes and stoppages in violation of contract, jurisdictional disputes, and undue restriction of production. The public is adversely affected by the interruption of public services or the flow of war materials, high prices resulting from unreasonable union activities, and the vicious influence of union racketeering.

Such practices, as the author carefully points out, are rather exceptional, and are most commonly encountered in immature unions and in the racketeering and anti-social fringe of unionism. Moreover, he notes, "in the turbulent and emotionally charged field of industrial relations labor has not been guilty of all the evils and excesses." Management's conduct, however, has been restricted considerably in recent years by effective legislation. "Would not (government) regulation likewise remove the worst union practices, to the gain of the worker, employers, and the general public?"

Even the unions' growing realization of their responsibility, the author believes, can only postpone government regulation. It is not regulation that the unions should fear, however, but regulation proposed or administered in the spirit of anti-unionism. He believes that two measures of governmental control would clearly strengthen the loyalty of union members and are now desirable: (1) the prohibition of unreasonable membership restrictions and (2) provision for the impartial review of disciplinary procedure. Among other proposals discussed favorably, but not recommended for immediate adoption, is the establishment of a governmental board to which employers could appeal for the settlement of jurisdictional disputes.

The discussion of practical methods for increasing union responsibility, appearing in the concluding chapter, is particularly stimulating. This thoughtful and competent volume deserves careful study in connection with any future proposals of regulatory legislation.

ROBERT J. MYERS

U. S. Bureau of Labor Statistics

Cost Behavior and Price Policy, by The Committee on Price Determination. New York: National Bureau of Economic Research. 1943. xix, 353 pp. $3.00.

I hope that nothing that is said in this book review will do other than

encourage statisticians to read the book for themselves. This is especially important because the principal value of the book to them lies in its clarification of particular cost and pricing problems; in its stimulus to further thought and discussion on the nature of costs and their relation to prices; and in its many practical suggestions for further research. This is not to deny the importance of the observations and findings of the survey but rather that in addition to being important in themselves they will be of even greater importance in stimulating further thought, discussion, and research. The book is on the whole a firmly practical springboard for future inquiry.

This is in keeping with the spirit in which the book was written and in accordance with the following statement in the Introduction: "The Committee will be content, therefore, if this report is accepted as an introduction to a body of imperfectly known material, as a critical appraisal of existing studies of cost behavior, and as a presentation of suggestions for further research."

The book is concerned for the most part with the behavior of costs in the individual enterprise and to a lesser degree with the implications of this behavior in the establishment of price policy. The authors do not pretend to have covered all of the cost problems of the individual enterprise nor to have made a complete study of the principal cost problems of such an enterprise. This becoming modesty should not be taken to mean that the survey is superficial. It goes deeply enough for one plowing of the field and provides ample suggestions for deeper investigations of particular problems.

Part One of the book deals with the character of costs as considered in economic theory and in accounting practice, and suggests that neither of these concepts is really satisfactory for the type of research into cost behavior that the authors favor. The authors show restraint and fairness in reviewing economic and accounting concepts of cost but point out that " . . . a great deal remains to be done in the process of translating theoretical structures into statistically measurable concepts, and of expanding accountancy into a more logical and useful system. The present volume is intended as a step in that direction."

Part One also presents "a preliminary examination of some of the complexities in the meaning and measurement of price." Here as elsewhere the practical problems of the businessman as well as the theories of the economist are recognized.

As stated by the authors, "The substance of the volume is represented by the analysis of Part Two. The thread of this analysis, to which the discussion of the various chapters is tied, is a consideration of the problems of isolating the influence of a single variable among the many which simultaneously affect costs. It must be admitted that the thread is a tenuous one, that its frequent breaks are patched up only with difficulty, and that the authors wander on occasion into other fields. Their excuse must be that the material is in many places scanty and that very little systematic work has been done in this area. A common structure is apparent in all the chapters in Part Two

and serves to focus attention upon the principal objectives with which all are concerned: a consideration of the statistical problems involved in the study of the influence of certain factors on costs, a critical evaluation of existing materials and studies, and suggestions of further research possibilities."

Part Two includes an analysis of empirical studies of the relation between variations in output and costs. The studies are of three types, namely "statistically derived cost functions" based on the accounting records of particular companies, "estimated cost functions," that is, " . . . estimates by engineers and accountants, presented as cost functions and focused on past experience," and "cost-revenue charts" (break-even charts) of two types, one based on historical records and the other based on budgets.

The titles of the chapters in Part Two are: Costs and Rate of Output, Prices of Input Factors and Cost Behavior, Technical Change and Costs, Allocation of Costs Among Products, Selling Costs, and Costs and the Size of Plants and Firms.

Part Three deals briefly with the implications of cost behavior for price analysis.

Several studies are presented as appendices because they are of interest in the area of cost behavior but do not tie directly into the body of the report.

In closing I should like to suggest that most of the problems considered in this survey are likewise of concern to the managers of smaller companies in which there are no staff economists or statisticians to interpret the language of such a survey. I hope that the Committee on Price Determination will give serious consideration to the problem as to how information of this type may best be conveyed to such managers.

C. B. NICKERSON

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Graduate School of Business Administration

Financial Accounting, A Distillation of Experience, by George O. May. New York: The Macmillan Company. 1943. ix, 274 pp. $3.00.

The sub-title of Mr. May's book describes its character. It traces the outstanding controversial theories of accounting as they have developed over the last third of a century, in the light of changing public policies, such as taxation and regulation, and as they have been influenced by marked changes in price levels and industrial activity. This maelstrom of conflicting interests and attitudes of accountants, businessmen, lawyers, and politicians is the basis for his thesis that "The rules of accounting, even more than those of law, are the product of experience rather than of logic." Throughout the book he illustrates this view by pointing out that many of the difficulties accountants face result from attempts to make foresight out of hindsight.

The book is well-organized. In its separate treatment of the problems aris-

ing under the general headings of cost, value, and depreciation of fixed assets; liabilities; and income; Mr. May has developed the antagonistic premises of the conflicting accounting doctrines that are advocated for the solution of the various problems involved. His thesis that the accounting rules to be applied depend upon the purpose the accounting is to serve is well made. The book brings out clearly the great difficulty modern corporations face in attempting to prepare income statements and balance sheets that adequately set forth the important facts of prime interest to their stockholders.

The book should be required reading for all those aggressive, socially minded spirits who attempt to reinforce their arguments for drastic legislation by naive calculations based on simple aggregates of corporate accounting statements. The book should also be required study on the part of all public officials having to do with the financial policy of corporations.

There is one curious omission from the book that deserves comment. Mr. May does not adequately explore, in this reviewer's judgment, the theory of valuation based on "replacement cost" (as distinguished from the theory of "reproduction cost"). "Replacement cost" is the most realistic approach to the valuation of fixed assets in a world in which those values are undergoing constant change due to technological developments. Regardless of accounting theory, most of the decisions of businessmen as they affect the purchase of such assets are based upon replacement cost. This will be the central point of controversy in the period ahead in connection with the disposal of the enormous quantity of fixed assets which the Federal Government has acquired for war production.

STEPHEN M. DUBRUL

The New Philosophy of Public Debt, by Harold G. Moulton. Washington: The Brookings Institution. 1943. vi, 92 pp. $1.00.

This brilliantly written and closely argued pamphlet restates in a popular fashion the conservative (classical) point of view with regard to a huge and growing public debt. With a keen dialectical ability, the position of the heterodox New Philosophy—which is in reality in no sense a new one—is analyzed. The polemics is directed primarily against Professor Alvin Hansen, with occasional salvos fired at Mr. A. A. Berle, Jr., Professor Seymour Harris, and the defunct National Resources Planning Board. The main approach of the author consists in refuting, so far as his space permits it, the arguments current at present in favor of a "permanent" public deficit: that our economy has become mature, unable to produce progress unless aided by income-creating (net) government expenditures; that a permanent excess of savings exists, to the detriment of new investments; that the excessive liquidity of corporations eliminates the demand for capital on the open market, leaving a gap to be filled by government borrowing; that an internal debt is no debt at all ("we owe it to ourselves"); that credit expansion for public purposes is just as "productive" as that on business accounts;

and that inflation can be controlled without resort to totalitarian regimentation.

Dr. Moulton's approach is polemical throughout, with emphasis on the lack of precision and consistency of his opponents, a task that is made particularly difficult by the technique of literary "hedging" in which Professor Hansen excels. But with all its merits in lucidly presenting, within a short compass, the ramifications of a profoundly comprehensive topic, this pamphlet leaves the reader without effective guidance. In the first place, essential problems involved are altogether neglected in Dr. Moulton's analysis, as they are in that of his opponents. The inflation problem, e.g., is discussed as if it were merely a matter of balancing the budget, omitting to give as much as a passing hint to the consequences which the accumulation of vast holdings of liquid savings may entail. Just as his adversaries do, Dr. Moulton argues about the size of the debt, without regard to its composition: both sides seem to ignore the very significant (monetary) difference between short and long maturities. Nor is much attention paid by either side to the fact that a systematic pump-priming monetary policy amounts in effect to the permanence of governmental subsidy distributions, with far-reaching effects on competition, industrial progress, economic and political "equilibrium," etc.

Secondly, Dr. Moulton gets into "deep water" by attacking the theory that wealth can be created by the creation of government debt. The irony of the situation is that representatives of that theory, such as Mr. Berle, use Dr. Moulton's authority on its behalf. Indeed, it was our author himself who, some twenty-five years ago, revived John Law's thesis that the granting of credit for the proper purpose is a process of wealth-creation. If that were true, if long-term credits extended by banks to industrial firms are "productive," why shouldn't the same credits, originating from the same banks—even though through the purchase of government bonds, the proceeds of which are used for the identical purpose—do the same trick? There are many examples available to show that governmental credit institutions can finance ventures of a "self-liquidating" nature, in the Moultonian sense, just as banking houses do. Dr. Moulton is caught in his own line of reasoning. Obviously, his own theoretical chickens came home to roost, so to speak, leaving one of his principal arguments against the continuation of governmental deficits without logical foundation. But his lucid and incisive criticism of numerous other inflationary reasonings gives this little book a distinguished place in the current discussion of our basic financial problem.

MELCHIOR PALYI

Chicago, Illinois

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Barger, Harold, and Sam H. Schurr. *The Mining Industries, 1899–1939: A Study of Output, Employment and Productivity.* New York: National Bureau of Economic Research. 1944. xxii, 452 pp. $3.00.

Beck, Dorothy F. *Costs of Dental Care for Adults under Specific Clinical Conditions.* Lancaster: Lancaster Press, Inc. 1943. 306 pp.

Bennett, M. K. *Food for Postwar Europe: How Much and What?* Stanford University: Food Research Institute, War-Peace Pamphets, No. 5. 1944. 100 pp. 50 cents.

Bergson, Abram. *The Structure of Soviet Wages, A Study in Socialist Economics.* Cambridge: Harvard University Press. 1944. xvi, 255 pp. $3.50.

Cantril, Hadley, *Gauging Public Opinion.* Princeton: Princeton University Press. 1944. xi, 318 pp. $3.75.

Davis, Joseph S. *Food as an Implement of War, The Responsibilities of Farmers.* Stanford University: Food Research Institute, War-Peace Pamphlets, No. 3. 1943. 20 pp. 10 cents.

Dornsife, Harold W. *Selection of Supervisors.* Los Angeles: The Ward Ritchie Press. California Institute of Technology, Industrial Relations Section, Bulletin Number 9. 1944. 38 pp. $1.00.

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McDougall, John L. *Railway Wage Rates, Employment and Pay.* Toronto: Longmans, Green & Company. 1944. 34 pp. 50 cents.

* Annual reports and publications presenting statistics collected at regular intervals have been omitted from this list. Some items of minor interest to statisticians have also been omitted. The contents of periodical publications are not listed, but the attention of the reader is directed to the lists of articles in current publications which are to be found in the *Revue de l'Institut International de Statistique, Journal of the Royal Statistical Society, American Economic Review, Population Index, Transactions of the Actuarial Society of America, The Record of the American Institute of Actuaries,* and *Sankhyā The Indian Journal of Statistics.*—Editor.

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Meany, George, and R. J. Thomas. *Recommended Report for the Presidential Committee on the Cost of Living.* Washington: Congress of Industrial Organizations. 1944. 104 pp. 25 cents.

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Saulnier, Raymond J., and Neil H. Jacoby. *Financing Equipment for Commercial and Industrial Enterprise.* xv, 95 pp. $1.50.

Schlotterbeck, Karl T. *Postwar Re-Employment, The Magnitude of the Problem.* Washington: The Brookings Institution. 1943. 27 pp. 25 cents.

Taus, Esther Rogoff. *Central Banking Functions of the United States Treasury, 1789–1941.* New York: Columbia University Press. 1943. xii, 313 pp. $3.50.

Vratzian, Simon. *Armenia and the Armenian Question.* Boston: Hairenik Publishing Company. 1943. ix, 107 pp.

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POST-WAR PLANNING FOR BRITISH OFFICIAL STATISTICS

BY RICHARD O. LANG
War Department

FOREWORD

IN THE *Journal of the Royal Statistical Society*, Vol. CVI, Part II, for 1943, there appeared a report to the Council of the Society on the subject of British official statistics. As this report is the first of its kind[1] to have been written in many years it was believed that this "Memorandum on Official Statistics" would be of interest to readers of this JOURNAL. Having worked in London for the greater part of eighteen months ending in February, 1944, working with British official statistics and statisticians, I was asked to select from the Memorandum important parts for summarization. It is my belief that the British experience in war-time and the hopes of the Society for the future may be useful to those persons in our country who are interested in looking forward to further development of our own Government statistical services.

INTRODUCTION

The publication of the "Memorandum on Official Statistics" by the Royal Statistical Society has given to the Society's members and to interested officials in the British Government a review of the existing organization of statistical services and recommendations for the post-war period. Official statistics have been the subject of investigation by committees of the Society for many years. As early as 1877 a committee was appointed to investigate the scope and organization of statistical work in the Government. One of its recommendations was that there be set up a small, central statistical office with limited supervisory author-

[1] The writer was in London in 1937–1938 as a Post-Doctoral Fellow of the Social Science Research Council and included in his work an examination of the work being done in official statistics in Great Britain. A brief summary of the findings of that investigation was prepared for the 24th Meeting of the International Institute of Statistics which met in Prague, Czechoslovakia, in 1938. The report was published by the Institute with an article on the United States by Stuart A. Rice, under the title, "The Organisation of Statistical Services in the United States and Great Britain."

ity. No action, however, was taken on this recommendation. After World War I a petition to the Prime Minister requested an official in-inquiry into Government statistics, but the committee appointed by the Cabinet in 1920 to review the petition recommended that although no case existed for an inquiry, there should be set up a consultative committee on statistical work of the Government Departments. This committee was established. It is of significance that the Royal Statistical Society should again set out to investigate the same problems but this time not waiting for the war to cease and the interest and importance of statistics to be forgotten.

The "Memorandum on Official Statistics" was the result of work done by a committee appointed by the Council of the Royal Statistical Society on October 13, 1942, with the following terms of reference:

> To consider and report upon the organization of statistics in Government Departments before, during and after the war, with special reference to—
> (a) the staffing of Departments;
> (b) the relations between Departments;
> (c) the advantages and disadvantages of alternative schemes of post-war organization.[2]

The committee consisted of Professor Major Greenwood (Chairman) Mr. R. F. George, Mr. M. G. Kendall, Mr. H. Leak, Professor E. S. Pearson, and Dr. E. C. Snow.

In the introduction to the report there is a brief discussion of definitions of "statistician" and "statistics," pointing out that "the science and methods of statistics in the modern sense range from the mere recording and tabulation of numerical data to subtle processes of inductive reasoning based on the mathematical theory of probability,"[3] and the word "statistician" being used to indicate anyone doing either the recording or the subtle processes of reasoning, or any of the work which lies between these two areas. The problem of establishing criteria for classifying a person as a statistician is mentioned, but not discussed; it is apparently left as a problem for attention of the Society in the future. The classification of statistical work is sufficiently interesting to be given in its entirety here:

> (a) "Descriptive" statistics, which cover the collection, summarization and interpretation of numerical material without reference to questions of sampling or the problems of representativeness associated with the theory of probability. The great bulk of departmental statistical work is "descriptive" in this sense. In its most primitive form it amounts to little more than recording and tabulating. The interpretation of the material, however, calls for that distinctive flair which is the characteristic of the true statistician. Such

[2] The *Journal of the Royal Statistical Society*, Vol. CVI, Part II, 1943, page 145.
[3] *Ibid.*, page 146.

interpretation is work of a very high expert order. The tabulator and summarizer we shall refer to as a "statistical clerk." The interpreter may fairly claim to be called a "statistician." His theoretical equipment need not be very large—it is rare in this class of work even for such elementary functions as standard deviations or correlation coefficients to be required—but he must possess an expert knowledge of the limitations of his material, be able to draw sound logical conclusions from them and (what is of great importance in the Civil Service) to express those conclusions in a form which can be grasped by the layman.

(b) "Mathematical" statistics, which cover the more specialized theory capable of application to testing the significance of sampling enquiries, to various forms of scientific experiment and to a whole range of problems in which the Government as producer or user is interested in the control of quality, whether of human beings or of products of industry. In many such problems it is being widely realized that the scientific approach is in fact the statistical approach. The statistician engaged in this class of work must have a considerable knowledge of mathematics and a scientific mind. He also should possess the flair for figures of his "descriptive" colleague, and if he is to pull his weight in any organization his analytical skill in mathematics must be tempered with common sense and sound judgment. There is not (or ought not to be) any antagonism between the descriptive and the mathematical statistician; in fact some people are both. The broad distinction is similar to that between the general practitioner and the specialist in medicine, and it is from this angle that the distinction becomes important for our present purposes.[4]

It is significant that the committee consisted of a balance between the "descriptive" and the "mathematical" statisticians, and the Memorandum clearly shows this balance throughout its pages.

THE PRE-WAR POSITION

The pre-war position on collecting statistics might be stated simply that each Department collected its own statistics. In many instances there was no statistical branch even in major Departments, and where such statistical offices did exist, the practice was for each office to deal with the data required for its own work. There was emphasis upon the administrative aspects of statistics, and it is readily understandable why the organization of statistical services, particularly the collection of statistics, was decentralized. The Departments had no general powers to collect statistics as they required them. The limitations on their work were far more severe than limitations imposed upon United States Government Departments in similar work. Certain regular activities of a few Departments were established by laws, the decennial population census, the annual agricultural census, the registration of births and deaths, and the like, but for the most part even these in-

[4] *Ibid.*, page 147.

quiries were carefully limited in the scope and number of questions which could be asked. Although there were few formal statistical inquiries, there had accumulated an enormous mass of statistics as by-products of administrative functions. The principal features of this mass of information seemed to be:

(a) That most of it was collected for some special administrative purpose or as a consequence of some administrative duty, and not for its own sake. As a result it was frequently not in the form most suitable for statistical study.

(b) That it was acquired by branches concerned with administrative work and was therefore sometimes not properly recorded and summarized.

(c) That in consequence of the system of collection by individual branches there was in many cases very imperfect co-ordination even between branches of the same Department in the collection of the material.[5]

These defects are familiar to many readers of this JOURNAL and could well describe some of the statistical work in our own Government agencies. Much has been done in the United States, however, to alleviate such strains by the co-ordinating work done first by the Central Statistical Board and now by the Division of Statistical Standards in the Bureau of the Budget.

Arising out of the defects in the system of collecting statistics were many inadequacies in the presentation and analysis of the data. The information was frequently summarized in a form which even the Department responsible for the collection had difficulties in fully utilizing the material. The greatest need was for better summarization and wider utilization of statistics already available. In those Departments which had separate statistical branches this criticism does not necessarily apply. But on the whole there were too many instances of information published in regular reports which were not fully utilized.

Along with these defects were the unsatisfactory results arising from untrained staffs trying to carry on the tasks of collecting, recording, and summarizing the information. Most of the work had been done by ordinary clerical officers who had no training either in descriptive or mathematical statistics. No technical statisticians were brought in to advise the Departments in their statistical work. (The exceptions to this, of course, are the four Departments who had separate statistical branches.)

The consultative committee on official government statistics mentioned in the first part of this paper was appointed to co-ordinate departmental statistics. The main work of the meager staff of the committee was the publication of an annual "Guide to Current Official

[5] *Ibid.*, page 149.

Statistics of the United Kingdom," and it exercised little influence on departmental statistical practices. Only in a few instances had any attempt been made either by this committee or through any other means to co-ordinate official statistics. Personal contacts among members of Departments may have accomplished what little co-ordination there had been, and the meetings of the Royal Statistical Society probably formed the only other place where men talked over common problems and plans. The pre-war position, as summarized in the Memorandum, is as follows:

> A general survey of departmental statistics before the war gives the impression of very wide differences in practice and performance. In only a few of the major Departments was there any statistical organization which can be regarded as adequate. In the others the limited needs of the Departments seem to have been met by improvisation. There was little liaison between Departments. The system under which each Department, and in many cases, each branch of each Department, was responsible for the collection and handling of its own statistical material, though containing useful features, tended to result in inadequate use being made of available material and in dissipation of effort. The staffing of Departments was unsatisfactory in regard to the training of personnel, and in certain respects to their status. Nowhere was a knowledge of statistical theory regarded as a necessary qualification for employment in statistical work and the technical post of "statistician" was practically unrecognized.[6]

WAR-TIME DEVELOPMENTS

In takes no expert imagination to predict what happened when war broke out in 1939 and the administrative Departments had thrown on them burdens for which they were never organized to carry. In addition the numerous new Ministeries, particularly Food, Supply, Aircraft Production and Economic Warfare, made immediate and large demands for statisticians of both the descriptive and mathematical types. Soon qualified personnel was in acutely short supply, and has remained so during the entire war period. The shortage has been so great that many persons now employed as "statisticians" in Departments have never had the training or experience which normally one would expect of personnel which claim that title. This is not much different, however, than some of the conditions in this country when our "defense effort" in 1940 called for "experts" in munitions production control organizations; "statisticians" found jobs which earlier would have required more exacting qualifications by the Civil Service examinations. The British found not only a shortage in technical people but the shortage in statistical clerks was severe enough to call for a scheme for training in the Civil Service. Concentrated courses of eight week's duration have

[6] *Ibid.*, page 153.

been given by the London School of Economics at Cambridge in order to get some qualified personnel into statistical offices in the various Departments. Not only the "descriptive" statistician was needed, but the complexities of modern warfare required the skills of the mathematical type as well.

From the long term point of view, however, the war has given statistics the greatest lift it has had in many years. Benefits derived from the extensive use of numerical data in all types of problems are many indeed. One of those benefits has been a changed attitude towards statistics and statisticians. Individuals and organizations are more willing than ever before to give information which is collected for administrative purposes and summarized in statistical form; the great increase in the amount and scope of questionnaires during war time has met with very little resistance. The public believes that a war must be run on facts, statistical facts. Besides the changed public attitude toward statistics, there has been a real change of heart among the Government Departments which in peace time regarded the statistician as follows: "at best he was considered a harmless drudge, at the worst a nuisance who was apt to produce figures at the wrong moment to weaken a promising line of argument."[7] Government Departments now seek for statistics and the statisticians qualified to analyse them.

The most significant war-time development, and of particular interest to us Americans, was the establishment of a Central Statistical Office within the Offices of the War Cabinet, in 1941. Its main functions include:

> (a) to ensure that the requisite figures should be collected by Government Departments in a systematic manner;
>
> (b) to arrange, when necessary, for inter-departmental discussions on all statistical questions;
>
> (c) to maintain day-to-day liaison between the statistical branches of the Departments and with the Central Executive, so that agreed figures could be accepted and used without question in inter-departmental discussions;
>
> (d) to compile statistical information for the War Cabinet and its Committees;
>
> (e) to act as a central organization for the circulation of statistical information between Departments.[8]

The establishment of the Central Statistical Office came after the country was used to running on a war-time basis. Accurate and current information on many subjects was required. The weaknesses of the pre-war organization for statistical work were brought into bold relief, particularly the inter-departmental liaison. "The close relationship be-

[7] *Ibid.*, page 156.
[8] *Ibid.*, pages 154–155.

tween such diverse matters as shipping and agriculture, aircraft production and rubber stocks, food rationing and recruiting programmes—to mention only a few—meant that there was a keen necessity for some body which could bring all the statistical information together and reduce it to a coherent and comprehensible form for the Government's use."[9] The Central Statistical Office has acted as an impartial, objective agency to present complete, related statistical data, and fortunately has had no axes to grind, no departmental obligations to fulfil, in presenting the information one way or another. It has improved the collection and presentation of statistics by the Departments themselves by requiring a higher quality of product for use in the Consolidated Statistical Reports prepared by the Central Statistical Office. The Office has been a co-ordinating agency in the field of official statistics, both descriptive as well as mathematical.

REQUIREMENTS FOR THE POST-WAR PERIOD

The two principal post-war problems investigated and reported on by the Committee who prepared the Memorandum were (1) the staffing of statistical units and (2) the co-ordinating machinery. The consideration of several schemes of post-war organization was based on the assumption that "the Government's demand for comprehensive statistical information during war-time will continue into the post-war period and beyond."[10] It was believed that State intervention in many post-war developments such as social insurance, national or international regulation of exchange, currency and trade would make it impossible for the Government to go back to the pre-war organization. Government Departments have tasted the fruit of statistics and probably will be unwilling to forego it in their post-war diet. The Committee assumed that statistics and statisticians were there to stay.

The Committee's comments on and recommendations for the post-war period are comprehensive. The Government Departments have not had full-time statistical offices as they are known in United States Government service. The recommendations, therefore, are far-reaching, but at the same time do not appear too radical in the light of the present administrative machinery in the major Departments. Compromises with existing Civil Service regulations and practice had to be made, the scale of salaries and the status of the statistician in the Departments had to be considered. These, and related issues, are woven into the final recommendations appearing in the Memorandum. Recommending that every major Department have a statistical branch with an officer of

[9] *Ibid.*, page 155.
[10] *Ibid.*, page 157.

the administrative grade, the Committee nevertheless recognizes the importance of not disrupting existing machinery for certain work. Decentralization on the collecting, recording and summarizing levels are taken for granted.

One of the more serious problems is that of getting qualified staff for the proposed branches. It has already been pointed out that staffing the war-time agencies admitted to the ranks of statisticians many who would not qualify for such work under pre-war requirements. In its recommendations the Committee suggested the following:

(a) There should be definite statistical appointments carrying salaries comparable with senior officers in the administrative grades.

(b) A special recruitment policy should be established which would bring technically qualified statisticians into the Civil Service.

(c) Junior administrative officers should be required to spend some time in the statistical branches in order that administrators of statistical branches would have some familiarity with statistical methods.

(d) Positions of technical statisticians should be established in some Departments to give sound statistical advice as well as for the work of interpretation and analysis of Departmental statistics.

(e) Departments should not be limited to selection of supervisory and junior staff from within the Departments, if it is found that there are not suitable personnel available.

(f) In-service training courses in statistics, begun during the war period, should be encouraged and extended.

The Committee felt very strongly that the status of the statistician should be on the highest plane, and to ensure that this status might be attained it recommended that the statistician's role in departmental work go beyond statistics into the field of administration; top administrative grades in the Civil Service carry high prestige in Government circles.

In the view of the Committee, of highest importance in the requirements for the post-war period is the co-ordination of statistical work of the Government Departments. By co-ordination the Committee included the output of Departments, the standardization of practices, and the status of the personnel. It was clear to the Committee that the only practicable organization to be charged with functions of co-ordination would be a Central Statistical Office. Rather than summarize the Memorandum of these points, full quotation of the pertinent paragraphs is given:

> The existence of a Central Statistical Office at the present time and the necessity for that Office to continue in existence for some time after the end of the war may render it more easily incorporated into the future Govern-

ment organization than if it had to be set up afresh, as was recommended by the Society after the last war. It is of prime importance that the head of the Office should be selected for his personal as well as his statistical qualifications. He would occupy a post of the greatest importance and responsibility, and in view of the proposed functions of the Office in regard to co-ordination he should not only command the respect of statisticians inside and outside the Service, but be able to maintain close and cordial relations with many Departments with whom he would come in contact. Much would depend on his initiative, tact and vigour, and we think that these qualities, rather than statistical eminence, should determine his selection.

One of the important functions of the Central Statistical Office would be to standardize the methods of different Departments (e.g., in regard to definitions, classifications and time periods) and to co-ordinate their work in order to ensure comparability, the avoidance of duplication and the collection of adequate material where required for the Central Government. The problem is to ensure that the co-ordination will be really effective and that Departments shall work harmoniously as part of a national statistical service without encroaching more than is necessary on individual freedom of action. It would assist in this direction if the Central Statistical Office were advised by a small Committee of not more than, say, six or eight members selected from among the heads of statistical branches in the major Departments for their outstanding statistical qualifications. The same Departments would not invariably be represented, and vacancies should be filled on nomination by the remaining members. The Chairman of the Committee should be the head of the Central Statistical Office, and that Office should be under an obligation to consult the Committee on all important questions. Probably regular meetings of the Committee would be advantageous in keeping the members in touch with current problems and in touch also with one another. To make the Committee as effective as possible we recommend that it should be empowered to initiate subjects for discussion, and to issue reports on statistical matters which do not fall within the province of any single Department. We think that in this way the Committee would carry great weight and its decisions would generally be acceptable to all parties concerned. In the event, however, of objection being raised by any Department, there should, we think, be suitable machinery for referring the matter at issue to an appropriate Committee of the Cabinet.

We contemplate that there will be need for an Economic Section of the Cabinet after the war and that the Central Statistical Office will form a parallel unit. In this capacity it would have the primary duty of compiling statistical information for the Cabinet and its Committees on subjects where the interests of more than one Department are concerned.

Though there may be divergence of views as to the detailed post-war organization of the Central Statistical Office, the following principles should, in our view, be observed in reorganizing the Office after the war:

(a) It should be no part of the duty of that Office to relieve Departments of their responsibility for collecting and compiling statistical data. There is no suggestion that such work should be brought together under one enormous unit.

(b) The Office should be divorced as far as possible from routine analysis and from administration.

(c) It should be charged with the duty of preparing statistics required by the Government, such as the Budget White Paper, or by such bodies as Royal Commissions and special Committees appointed by the Government.

(d) It should ensure that as much statistical material as possible is made available to the public and that all Government statistics are issued with the minimum of delay.

(e) It should endeavour to fill gaps in statistical information by advising Departments on the desirability of certain lines of enquiry.

(f) It should undertake research work or loan staff to assist other Departments in undertaking such work.

(g) It should act generally as a co-ordinating body.

(h) It should be responsible for the issue of the *Statistical Abstract for the United Kingdom* and the *Guide to Current Official Statistics.*

(i) It should also be responsible for the publication of a monthly bulletin of statistics on the lines of the *Survey of Current Business* by the United States Department of Commerce.[11]

The Committee regarded the Central Statistical Office as a kind of reservoir for trained statisticians who could be loaned or transferred to statistical branches in the Departments. The Office could also act as a place where Departments might station one of their staff for further training, and the experience on this new level would be invaluable not only to the person stationed but also to the Department. Such an organization would also enhance the uniformity of practice between departmental statisticians as well as provide an unequalled opportunity for contact and future liaison.

The Committee was fully cognizant of the time required to put into effect the proposals presented in the Memorandum. It recognized that governmental organization and procedures cannot be changed in a few weeks or months. The co-ordination and improvement of statistical practices, the raising of statistical standards, the fuller utilization of statistics in administrative work and the enhancement of statisticians' prestige in the Government—all these were expected to take a period of years to accomplish.

[11] *Ibid.*, pages 161–163.

INTERNATIONAL PROGRAMMING OF THE DISTRIBUTION OF RESOURCES: A SYMPOSIUM*

I

THE PROBLEM OF COMBINED PLANNING

BY WILLIAM L. BATT
War Production Board

IN CONSIDERING the possibilities of combined planning in the international field, we have a great deal to learn by looking back at our own national planning in these years since the National Defense Advisory Council began to work over in the Munitions Building.

The task of the War Production Board and its predecessors has been to divert resources, which in peace time move under the direction of private markets, to the production of weapons of war and essential civilian goods, and to maximize the use of all our resources and achieve a maximum production of the things that we want in war time.

This task involved the mobilization of all our resources, of which the accumulated skill, experience, and willingness of our people comprised our most important asset. What we had at the beginning of the war in the way of inventories and facilities was far less important than what we had in the way of a skilled labor force, managerial business and public experience, and the skills of the highly trained professions.

The success of the war production effort rested largely upon maximum utilization of the skills of the workers; the experience of the managerial groups, the knowledge of technicians, engineers, and natural scientists; and last, but not least, the technicians and scientists in the field of economics and other social sciences. Of these, skill and experience in the field of measurement of resources, production, distribution, and consumption of commodities and services, on a nation-wide scale (and often on a *combined* basis), were fundamental in the management of the war production effort.

As we all know, the job of mobilizing for war has been much greater in the present conflict than it was in the first World War. Further, we faced the task of mobilizing for war against a background of national danger and an urgent need for quick action even greater than in 1917.

* These papers devolve from a dinner meeting devoted to a discussion of the Combined Boards held in Washington, May 6, 1944, as a part of the Regional Meetings of the American Statistical Association. The session had six United States, British, and Canadian participants. The present symposium contains the remarks of Mr. William L. Batt, International Vice Chairman (International Supply) of the War Production Board, who presided at the session and directed the discussion, as well as the comments of one British and one American participant.

In this enormous task, a knowledge of our resources, potentialities, and requirements, such as could be provided by statistical measurement and controls, was fundamental.

It was indeed fortunate that when the defense period began, and especially from the time of our active participation in the war, we had available statistical data and techniques, and a reserve of experienced economic statisticians and analysts to a far greater extent than in World War I.

Since the last war there has occurred a great enrichment of our economic statistics and of the experience in applying statistical tools to problems of the national economy. The work of the Department of Commerce and of the Bureau of the Census secured great impetus from the lack of data shown during World War I. Research institutions, such as the National Bureau of Economic Research and the Brookings Institution, were World War I babies, founded by people like Brookings, Edwin F. Gay, and Wesley C. Mitchell as a result of their experience in the old War Industries Board. With the resulting increase in data and analysis, academic training began to emphasize quantitative analysis of problems of the national economy; and thus raised the level of statistical experience and analytical capacity of the generation graduated after World War I.

Statistical analysis enters into the work of the War Production Board in many ways. Only a few of the more important will be mentioned here.

First, we had to see what the economy could produce in order to get a basis for determining the over-all size of military production programs that could be carried through. In this work we have used data, in large part familiar on the total national product, the size of the labor force and the extent to which it could be expanded, the supply of critical materials, levels of past and possible civilian consumption, and so on.

Here there was a long evolution, from the early days when emphasis was on showing how large the munitions programs could be and pressing for an early formulation of such programs in anticipation of the conflict, to later phases when the cumulation of programs, each elaborated by the several military agencies, threatened to exceed the productive capacity even of our great economy and result in dislocation; to still later phases when military and civilian programs were in general balance with the capacity of the country, leaving room only for special problems; and finally to recent months when planning for a possible decline in the war production levels began to be practicable.

Secondly, we had to analyze closely the supply and requirements for certain critical types of resources—materials, various types of pro-

ducers' goods, facilities, transportation (particularly shipping), and more recently labor. In this case, the detailed programs of the several claimant agencies had to be analyzed, translated into the claims which they represented—quarter by quarter—upon limiting resources, and compared with the supply of such resources that could be assured. These were basic to decisions either to expand the resources, or to moderate the claims, or to do both. In a sense, this laborious task of statistical matching of demand and supply—not in market but in war production planning terms—was a detailing, on a shorter time scale, of the broader type of planning and programming.

Third, in addition to analyzing the forward programs and claims, as well as the future supply of resources, the statisticians had to sharpen their tools for recording what was being actually accomplished. In this task, there were encountered the usual problems of accurate and prompt reporting at the least cost; of bringing together the reports in a unified form, comprehensible to the executives who were responsible for decisions; of analyzing what happened with emphasis on the choke-points that called for immediate attention—in short all the usual problems of statistical control magnified enormously by the scale of operations and fluidity of events.

In these various ways, and in many others, statistical work in the War Production Board has been fundamental in: (a) providing the broad framework within which policy could be laid down; (b) checking conflicting claims, and reducing the area within which decisions had been made by hunch; (c) assisting us in keeping abreast of events and aware of what portended in the future.

Naturally, there were shortcomings. Because of lack of data, the conclusions could not be detailed, and in some cases too much room was left to decisions by hunch. Because of the fluidity of events, the broad plans in some cases showed unwarranted biases. Because of the difficulty of reducing the thousand-and-one things to common denominators, there was sometimes disagreement among the statisticians and economists themselves, to the confusion of the policy executives. But one could claim that the shortcomings were within the margins that have to be tolerated in a generally imperfect war-disturbed world.

The applications of statistical techniques and data, such as were made in the War Production Board, should provide a basis for rapid progress of the discipline in the post-war future and of its application to post-war problems of the national economy.

This would parallel the development after World War I. And perhaps one could hope that the comparatively successful use of the techniques during the war would be followed by a similarly successful use after the

war, certainly on any economic or social problem on which we shall secure the same unanimity of social will as we had during this war effort. Even on problems on which disagreement may justifiably exist, the application of statistical techniques should at least narrow the area of legitimate controversy.

There has been general recognition of the great impetus which war gives to the advancement of technology in the natural science and engineering fields. Most people are at least generally cognizant of the potential gain to human welfare that may come from the developments of this war of penicillin, of blood plasma uses and techniques, of the tremendous advance in insect-control devices which promise to revolutionize our methods in the field of epidemiology. We can look forward to widespread civilian use of such devices as radar, and numerous aircraft developments, and the many new applications of mass-production techniques to precision instruments which formerly could be produced only in small volume and by painful effort.

But there has been less general recognition of the similar impetus which the catalyzing effect of unified national purpose has given to the development of data and methods essential to the understanding of national and international economies. Our abilities to deal with problems in this field may be fully as decisive to human welfare as anything in the field of natural science or engineering. There is good ground for optimism that the work done by our economists and statisticians in this war, built upon a foundation forged in World War I, will serve to further the great task of fashioning a post-war economy that will minimize the scourges of world poverty and disastrous recurrent depressions.

Turning now to the work of the Combined Boards—but leaving to the two following papers the explanation of how the Combined Boards operate and what their detailed accomplishments have been—something very briefly should be said about the general principle on which the Boards have operated, at least the Combined Production and Resources Board and the Combined Raw Materials Board and something also on the possibilities of combined planning in the future.

Two things about the work of the Production and Resources and the Raw Materials Boards should be emphasized. Both have to do with the word "combined" that appears in the title of each. First of all, the Boards and their charters establish the principle of pooling of resources of the United States and the United Kingdom (and in the case of the Combined Production and Resources Board, also of Canada). In the raw materials field, for example, we have really worked on the principle of "what is thine is mine, and what is mine is thine." In the interests of winning the war, every pound of the materials originating in the

British Empire or the United States has been available for use in either country where it can do the most good. Secondly, the Combined Boards have provided a common table around which ideas, opinions, and problems, as well as resources, could be pooled. The Boards have not operated as autonomous agencies and independent of the operating departments of the Member Governments. In effect, the Boards *are* these national agencies. On the American side, the Boards provide a place where the War Production Board, the Foreign Economic Administration, the Department of State, the Department of Commerce, and other American agencies can bring their problems in the international field and talk them out with their British opposite members until agreement is reached. This point cannot be over-emphasized. Without an intimate two-way flow of opinions and recommendations between the Boards and the operating agencies, successful planning on a combined basis would have been impossible. But with this cooperation, the Boards' actions have been taken with the benefit of the experience and advice of all the operating agencies concerned, and the Boards' recommendations have been implemented without question, because in every case these recommendations were in effect also the recommendations of the operating agencies who were responsible ultimately for putting them into effect.

The Combined Boards are war-time agencies. They are not equipped in their present form to carry over into the post-war period. Their job has been to solve the problems of war-time shortages, and their job will be largely done once these shortages disappear. In my mind, however, it would be nothing short of tragic if the accumulated experience of the Combined Boards in the field of international economic cooperation were to be lost. I am a firm believer in the advantages of private enterprise and free markets. I am also a firm believer in the absolute necessity of international cooperation in the economic as well as in the political field. Peace and progress will depend upon that cooperation being secured. I believe the Combined Boards show how successful such cooperation can be when there is complete agreement as to objectives and as to the general means of achieving these objectives. It will be up to us and the peoples of other nations to see that the agreement as to ends and means is secured for the post-war world.

II

STATISTICS AND COMBINED PLANNING

By R. G. D. Allen
Combined Production and Resources Board

IMPROVEMENT of economic statistics, nationally and internationally, during the war has been pronounced and the Combined Boards have encouraged some of the improvement. Though this applies specifically to statistics in the United States and the United Kingdom, it applies in varying degrees to other countries—to Canada which is a member of several of the Combined Boards and to such United Nations as Australia, India and Brazil which are not directly represented on the Boards.

Particularly, statistical material in the broad economic field has been very greatly improved during this war in the United States and in British countries. This would have happened, to a considerable extent, if the United States and British had fought the war independently of each other. It happened in the war of 1914–18 when much of the planning was, in fact, done independently. The outstanding characteristic of this war, however, is the extent of Anglo-American cooperation. This has accelerated the advance in the quantity and quality of national statistics and has directed it on parallel and comparable lines in the various countries.

In this war, unlike the last, Anglo-American cooperation has been close from the beginning. Some strong links were already forged at the time of Pearl Harbor and many others have been added since. Washington and New York accommodate numerous British Missions, the personnel of which far outnumber the regular diplomatic and consular representation. The United States counter-invasion of London, though slower in starting, is now on a comparable scale. These groups are more than Missions to a foreign country. They are pulled together with the domestic government agencies through the system of combined organizations both on the military side under the Combined Chiefs of Staff and on the civilian side under such Boards as the C.F.B., C.R.M.B., and C.P.R.B.

Amongst the British in the United States and amongst the Americans in London are many professional economists and statisticians. Other United States and British experts are working side by side in Cairo, New Delhi and other distant places. The war has brought economists and statisticians together more often and more continuously than was ever possible in the more leisurely days of peace.

As a result, United States statistics have become more familiar to British statisticians, and British statistics to United States statisticians. Before the war, all that some British statisticians knew about United States statistics was that they were voluminous, incomprehensible and perhaps unreliable. Many of them can now pick the right series out of the small type in the *Survey of Current Business* at the first attempt—and can argue with at least some show of knowledge about the relative merits, for example, of the Bureau of the Census and the Bureau of Labor Statistics data on non-agricultural employment. Similarly, the horizons of the United States statistician have been extended. I have a feeling that some of them were wont to think that British economic statistics were scarcely worth a second thought. They are now far more familiar with the wartime confidential *Accounts Relating to Trade and Navigation of the United Kingdom* than they ever were with the similar statements published before the war.

This is not a case of familiarity breeds contempt. On the contrary, the amount of patient care and hard work that goes into statistical compilations can be appreciated only after close study and frequent use of the final product. Familiarity with the statistics of another country, moreover, may well turn the statistician into a reformer. United States and British statistics alike can be improved by a study of what is done in the other country.

The inescapable needs of the war economy in each country separately have led to extensive improvements in the national statistics. In the United States, I need only mention such published series as those on consumer expenditures, civilian labor force, hours and earnings in industry and the value of new construction; all these and many others have been developed or extensively revised since 1940. In addition, a mass of confidential material has been collected by United States war agencies covering almost every aspect of production, manpower, transportation and other economic fields. Some of this material is now being released, notably in *Facts about Industry* issued jointly by the Bureau of the Census and W.P.B. Much of the wartime collections of statistical data will inevitably be dropped but the utility of some of the new series is so evident that they have a good chance of survival after the war. In the United Kingdom, where government statistics have hitherto been the jealously guarded preserve of separate and individual government departments, an early wartime development was the creation of a Central Statistical Office within the Offices of the War Cabinet. Little of the work of the C.S.O. has been publicly issued except for the invaluable annual White Paper on the sources of war finance and the national income and expenditure. It can be said, however, that the regu-

lar statements prepared confidentially by the C.S.O. contain many statistical series which were not available before the war. It is clear from the trend in British government policy (e.g. the recent White Paper on *Employment Policy*) that the work of the C.S.O. in collecting and compiling statistical series in conjunction with regular government departments will continue when the war is over.

Domestic necessity has been the most powerful, but certainly not the only, influence in bringing forth data previously unobtainable. In numerous instances a request from an American agency in Washington or from an American Mission in London has disclosed that the needed information was not readily available in the United Kingdom. As a result the data have been collected, found useful and kept up-to-date; a new series has been added to British official statistics. Requests from Combined Boards in connection with the many subjects under consideration have likewise improved and extended British statistics. The same is true on the United States side, though here the result may be an improvement in existing data more often than a development of new series.

At this stage, a few words about the functions and organization of Combined Boards are relevant. The job of the civilian Boards is to make recommendations to the several national agencies concerning the production and allocation of foods, raw materials and finished products to the best advantage of the combined war effort. The Boards neither execute nor dictate. They serve to bring before the national agencies the world picture as opposed to the narrower view inevitably taken by government departments individually and separately. To be able to function at all, therefore, the Boards need to set up in business as fact-finding agencies on a global scale. Their organization has developed in several ways which cut across each other but which proceed primarily through committees handling particular commodities or concerned with particular areas. Whatever the grouping may be, the first need is for the statistical facts—about the world demand and supply position on fish or coal, on copper or textiles—about the needs of particular areas for relief and rehabilitation.

The concept of a world "balance sheet" for a particular commodity is simple enough—setting consumption and requirements against production and stocks. The technique of preparing such a balance sheet has been well developed by the Combined Boards and it is still being improved. Often the preparation of a balance sheet is enough in itself to disclose problems before they become critical and in time for the national agencies to take appropriate action. The success of this line of approach to combined problems depends on free and rapid exchange

of information between the agencies of the governments concerned. This has been achieved to a very remarkable extent during the two years that the Combined Boards have been in operation.

In many ways the work has been similar to some of the activities of the Economic Section of the League of Nations and of the International Labor Organization between the wars. There are, however, very important differences. In the first place, the Boards have not built up expert staffs to the extent undertaken by the League. Instead they have relied heavily upon the experts within the agencies of the several nations concerned. This has had the advantage of keeping the Boards extremely close to those ultimately responsible for national statistics while bringing together the experts from individual countries. Secondly, though the problems raised for combined consideration often do not have the breadth and scope of those taken up by the League, they are usually much more specific and certainly of more immediate urgency. In short, something has to be done about a problem and done quickly. The invasion of Europe cannot wait for months while, for example, exhaustive and careful examination is given to the question of the supply for coal for military operations and for the relief of liberated territories. A world coal "budget" must be drawn up quickly and kept constantly up-to-date. Such statistical problems as the comparability of various inventory figures must be resolved as far as possible in the time.

A good deal has been done on these lines and a large measure of agreement has been reached on such things as the definitions used in compiling data on steel supplies and stocks or the categories and units for the display of textile production figures. Under the auspices of the Combined Boards, expert missions have been exchanged between the United States and the United Kingdom to solve technical and statistical problems such as these. It is important that this work should not be lost in the postwar years.

Wider and more academic problems of an economic or statistical nature are being tackled to an increasing extent on an international basis, particularly as the questions of transition from war to peace are given more attention. These problems may be handled best at a series of international conferences such as those at Hot Springs, Va., in 1943 and more recently at Bretton Woods, N. H. The Combined Boards are directly concerned with these problems. As an example of what has been done there need only be mentioned the study of food consumption levels in the United States, the United Kingdom and Canada undertaken by the Combined Food Board. A survey of the results of this study has been issued publicly, some of the material being summarized in the President's *Fifteenth Report to Congress on Lend-Lease Operations.*

Other work of this nature in the fields of civilian consumption, man-power and national income has been done and is still proceeding. Material of this kind will be invaluable for economists to work on after the end of the war.

But the main legacy of the present combined planning for the war will not be any compilation of statistical material, or even a set of definitions and categories for comparable international statistics. It will be the wider experience and the international habits of thought acquired by so many economists, statisticians and other experts now in the service of their governments.

III

THE COMBINED RAW MATERIALS BOARD*

By R. A. Gordon

Combined Raw Materials Board

Organization of the Combined Raw Materials Board was announced by President Roosevelt and Prime Minister Churchill in January 1942. At the same time, formation of two sister combined agencies, the Munitions Assignments Board and the Combined Shipping Adjustment Board, was also announced.[1] The charter of the Combined Raw Materials Board provided that it should:

(i) Plan the best and speediest development, expansion and use of the raw materials resources under the jurisdiction or control of the two Governments, and make the recommendations necessary to execute such plans. Such recommendations shall be carried out by all departments of the respective Governments.

(ii) In collaboration with others of the United Nations, work toward the best utilization of their raw materials resources, and, in collaboration with the interested nation or nations, formulate plans and recommendations for the development, expansion, purchase or other effective use of their raw materials.

More than two years have passed since the Board was formed—enough time to indicate clearly the highly tangible and gratifying results that have grown out of the discussions of the President and the Prime Minister.[2] To date, the Board has issued nearly 300 decisions and about the same number of staff reports. More than 40 commodities have been brought under continuous review and have been made the subject of recommendations aimed at bringing supply and requirements into balance and insuring the orderly movement of adequate quantities from producing areas to the appropriate points of consumption.

Basically, the Board has performed the following functions. It has coordinated the activities of the United States and the United Kingdom in developing sources of supply where expansion was possible and needed to meet war-time requirements; it has exercised a similar co-

* The views expressed in this paper are entirely those of the author and not necessarily those of either the War Production Board or the Combined Raw Materials Board.

[1] Other combined agencies include the Combined Chiefs of Staff, announced in February 1942; and the Combined Production and Resources Board and Combined Food Board, both established in June 1942.

[2] The work of the Board has been described in detail in its First and Second Annual Reports, both of which have been publicly released. The first was issued in February 1943, and the second in May 1944.

ordinating role in planning the greatest possible conservation of use in consuming countries; it has recommended allocations to the various countries so as to achieve the most effective possible use of what was available; and, finally, it has provided a common table around which the interested agencies of the United States and the United Kingdom can work out answers to their day-to-day raw materials problems insofar as both countries are affected. A new and increasingly important function of the Combined Boards is to recommend allocations of supplies for relief and rehabilitation in liberated areas. This new activity looms larger in the work of the Combined Production and Resources Board and the Combined Food Board than in that of the Combined Raw Materials Board, since industrial raw materials will play a much less important role than food and finished goods in relief and rehabilitation programs.

In my opinion, the Board has been an efficient and gratifyingly successful organization. It has eliminated reckless and wasteful competitive buying in foreign markets between the major consuming countries in order to secure the maximum orderly flow of needed materials; it has helped to move promptly available supplies to points where they have been most needed; it has contributed to expanding supplies and to bringing about more economical use of materials in short supply. It has planned—in the very best sense of that over-worked word.

It also seems to enjoy the support and cooperation of all the interested operating agencies on both sides of the Atlantic. This cooperation is due in large part to the very wise policy initiated at the beginning that no decision of the Board would be made except after full consultation with all affected agencies. As part of this policy, all reports and decisions are cleared first with the government departments concerned, and on the Board's Operating Committee sit representatives of the State Department, War Production Board, Foreign Economic Administration, and Department of Commerce for the United States, and the comparable agencies for the United Kingdom.

At the end of two years of operation, the Board has been able to report that the raw materials battle has been largely won. While a few commodities continue to give grave concern, supply has been brought into balance for most of the important materials which bulk large in the war effort. (This is not to say, however, that in these cases all controls can be completely removed.) The wealth of resources open to the United Nations and their control of the shipping lanes are the primary factors responsible for this result. But the bottlenecks were broken sooner than they otherwise would have been because both nations agreed from the beginning on the need for central planning and co-

ordinated activities at all stages, from production through to final use.

In making its plans and recommendations, the Board has had the full benefit of all the statistical information that could be brought to bear on the subject under consideration. A simple statistical tool—a tabular presentation of stocks, supplies, and anticipated consumption (in Washington parlance inaccurately termed a "balance sheet") —has been the foundation of every commodity study prepared by the Board's staff. Not a few problems have arisen in achieving comparability between the production, stock, and consumption figures of the United Kingdom and the United States. Definitions, coverage, frequency of reporting, nature of the forms used by the supply agencies of each country in securing data from individual firms, and a number of other variables have added to the problem of securing reasonably comparable data.

The Board's staff has not sought for perfection. An admittedly substantial range of error exists in many of the figures and estimates that the Board has used, but the data have been good enough to provide a solid basis for the estimates and plans which have entered into the Board's work.

The wealth of information on particular commodities available to the Board will not entirely survive the war. Information reported to the national agencies is a direct function of the strictness of the controls imposed and of the degree of scarcity prevailing in the commodity. Already, as some materials have entered into a more comfortable position, controls have been relaxed and statistical information required of industry is being reported somewhat less frequently and in less detail than formerly. But the progress made in achieving international comparability has not been lost and should in good part continue into the post-war period.

For an economist, it has been a unique experience to deal with economic and business data and at the same time almost never see a dollar or pound sterling sign. The Board's data are almost exclusively in terms of physical volumes. It deals with requirements expressed in terms of pounds, tons, or yards, and with supplies expressed in the same units. Price is largely excluded from the picture. Evaluation of essentiality takes place, as it must, outside the traditional price mechanism. Data as to cost and price enter into the work of the various operating agencies, but the Board concerns itself with demand and supply expressed almost exclusively in "real terms." This is the essence of the rationing process, and the Combined Raw Materials Board, like the national supply agencies such as the War Production Board, has been charged with the responsibility for rationing industrial raw materials. Similar considerations apply in planning expansion of production. The

relevant costs are not those expressed in money terms but the "real opportunity costs," that is, what must be sacrificed to divert labor, materials, and equipment to this particular use and away from another line of production also important to the war effort.

THE FUTURE OF INTERNATIONAL ECONOMIC COOPERATION

The success of the Combined Raw Materials Board is matched in good part by that of the other combined agencies. This success naturally raises the question: Why cannot such international economic cooperation hold equally for the years of peace to come? Unfortunately, the experience of the Combined Boards provides more evidence of why it would be difficult to secure effective economic cooperation in the post-war years than a basis for expecting that international collaboration can be easily achieved. This is not to say that we cannot have international cooperation in the economic field—we can and we must. But we must not blind ourselves to the difficulties.

The success of the Combined Boards has been made possible by several favorable factors, none of which will exist in the same degree in the post-war world. First, and most important, there has been complete agreement as to objectives—the agreed aim, which has never been subject even to discussion, has been defeat of the common enemy. In the Combined Raw Materials Board, this has been translated into the criterion of producing and distributing raw materials so as to achieve the maximum flow of end-products needed for the war effort. This objective has been taken, quite properly, to be paramount and to override any and all differences of opinion that might arise. Thus the Combined Boards have been able to base their decisions on "supply" grounds with a minimum of reference to political, commercial, or financial questions that might be involved. When it has seemed necessary, public purchase has been substituted for private trade; sources of supply have been diverted from one country to another; materials have been transferred from one nation's stockpile to another's depleted inventories; equipment has been diverted from one production program to another; and so on.

What would be the common objective in the post-war world? It would be easy to agree on such general and vague goals as peace, security, full employment, the maximum welfare, and so on. But can these be translated into tangible aims for which each and every participating nation will be willing to make the sacrifices necessary?

These difficulties are well illustrated in the raw materials field. We should all agree in a general way that we want low prices for consumers, reasonable profits for efficient producers, and opportunity for employ-

ment for the workers of the producing countries. This is about the end of the agreement so far as I can see. One group would argue that the way to achieve these goals is by having a minimum of formal cooperation, the way to low prices and maximum employment being through the free play of competitive markets. At the other extreme are those who would argue that very detailed and close cooperation between governments is necessary to avoid the chaos that would result from unbridled competitive forces, particularly in the immediate post-war years. With these differences of opinion, it will be difficult to make even a beginning at international planning and cooperation when the procedures of war-time planning can no longer be justified. Assuming that these initial differences can be overcome and that international planning is attempted, there will still be countless clashes of national and business interests to be reconciled before agreement can be reached in any particular case.

The second condition making the work of the Boards relatively simple has been their limited membership. On the Combined Raw Materials Board, only the United States and the United Kingdom are represented, although a sister agency, the Joint Materials Coordinating Committee, brings Canada into a working partnership with the United States on raw materials problems. On certain of the other Combined Boards, Canada is also represented. Obviously, three-country representation is undemocratic. It can be defended only by the exigencies of war and the need of having an effective, compact organization among the major suppliers of war goods. In a post-war democratic organization, can forty-odd nations be effectively organized to provide for quick decisions with a minimum of disagreement?

A third condition which has facilitated the work of the Boards arises from the fact that it has been relatively easy to secure cooperation of all nations, even those not represented on the Board. It has been one of the Board's functions to increase production to meet expanded war-time demands. A producing country is likely to give its full cooperation under these favorable conditions. Would it do so equally well if international agencies were forced to take action that might cut that country's output or create for it serious problems of readjustment? Although seldom needed, the Board has also been able to use the weapons of shipping allocations and other sanctions, a normal part of war-time activities, which it would be difficult to impose in peace time.

It is well to reflect upon another point. The governments concerned have been able to take whatever steps have seemed necessary to gear their economies to the needs of total war. The machinery has therefore existed to implement the Board's activities. A good many of the Board's

allocations have assumed public purchase in foreign markets rather than unrestricted purchase by private traders. Much of the development work has been by public rather than by private enterprise. The Board's recommendations regarding conservation have been implemented by the full weight of the drastic war-time controls available to participating nations. These domestic controls and this willingness to sacrifice private enterprise if necessary will disappear when peace comes, at least in this country.

The Governments of the United Nations are now tackling the problem of constructing an international order which will make economic as well as political sense in the years after the war. They are aware of these difficulties and are undoubtedly taking them into account in their discussions. I shall not attempt to offer any suggestions as to how the difficulties mentioned can be overcome. I will say only this in conclusion. There is no simple and painless way to effective international cooperation, economic or politic. There must be commonly agreed and clearly defined objectives, effective organization, and willingness to sacrifice to some extent national interests for the benefit of the international body economic and politic. The Combined Boards offer some suggestions, but they certainly indicate no easy and painless solution to the problem.

ORGANIZING STATISTICAL WORK ON A FUNCTIONAL BASIS

By Harvey E. Becknell
U. S. Bureau of Labor Statistics

Nearly all statistical agencies of the Federal Government have been affected in one way or another by the war effort. For a few it has meant a curtailment of activities, but for many the statistical requirements of wartime policy making and administrative agencies have created an unprecedented expansion of data collection, processing and analytical facilities. These wartime demands have also sometimes necessitated considerable changes in the program and organization of the older statistical agencies. An adequate evaluation of the effect of the war on these agencies will require an exhaustive study in the post-war period. Case studies of the program and organizational changes made by specific agencies may, however, be of immediate interest and may contribute to a later general appraisal. It is from this point of view that the functional plan of organization, which has been adopted by the Prices and Cost of Living Branch of the Bureau of Labor Statistics, is presented in this article.

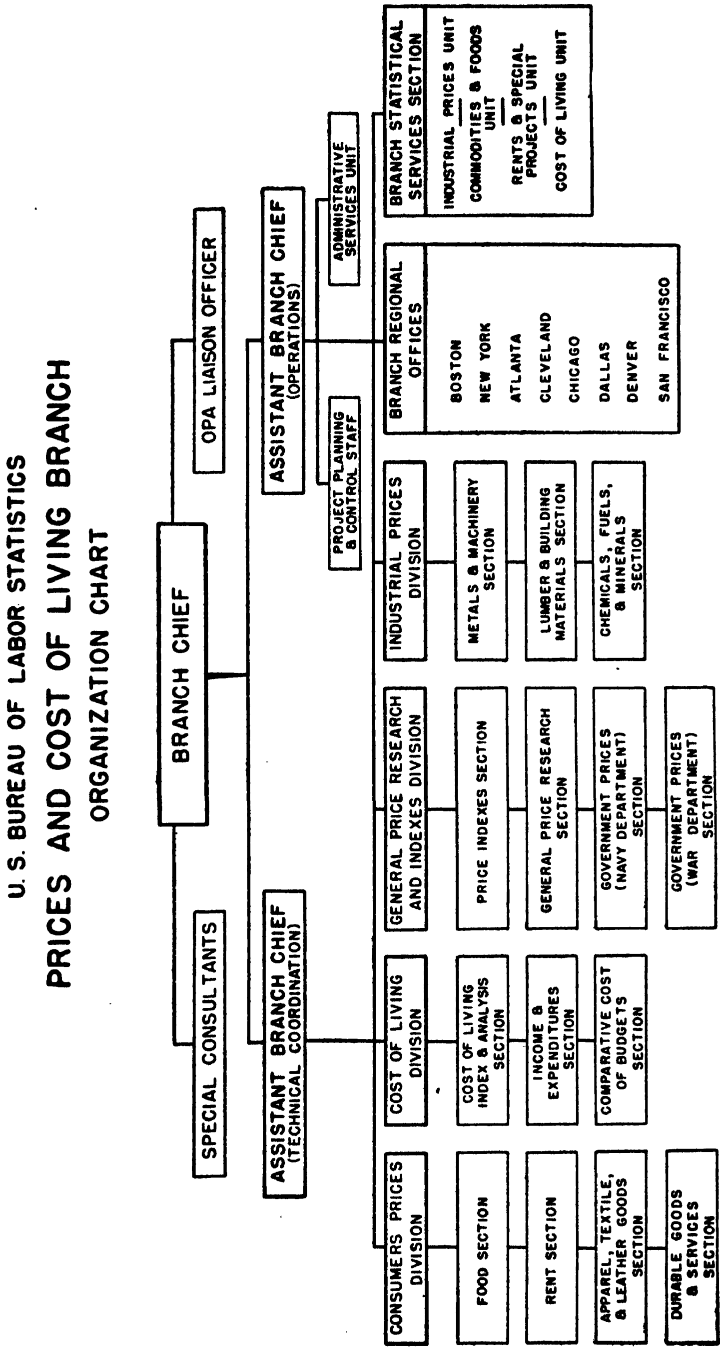
The term "functional organization" is used here primarily to designate a plan of operations in which the functions of program management are separated from those of research and in which these functions are handled centrally for the organization as a whole. In the case of the Prices and Cost of Living Branch, the term is also used to connote a separation of the functions of basic commodity price research and analysis from those of index number construction.

Developments leading to reorganization.—Up through 1940 the Prices and Cost of Living Branch carried on its work with a relatively small central office staff and with no field organization. Data from primary sources were collected by field representatives travelling out of Washington assisted by locally employed part-time personnel, or through mailed questionnaires. The planning and analysis work in the central office was conducted through three divisions, namely, Wholesale Prices, Retail Prices, and Cost of Living. Each division had its own statistical processing units, managed its own data-collection work, and handled the various stenographic and administrative services required by its own operations. General coordination of the work of the Divisions was effected through the Office of the Branch Chief. Such expansion of the Branch's work, as occurred prior to our entry into the war, was handled largely by additions to the staff of the then existing Divisions. However,

the tremendously increased volume of work which the Branch was called upon subsequently to do by the various war agencies, created organization and management problems of considerable magnitude. An idea of this increased volume of work may be gained from the fact that the total amount of funds available to the Branch for its regular work together with that for special services to the war agencies in 1943 was about five times the amount of its appropriations in 1940.

The Branch first attempted to meet the technical and operating problems growing out of this large expansion of its work by adding a new Division called the Price Analysis Division. This Division was staffed to handle exclusively the work for the Office of Price Administration and other war agencies. The Division grew very rapidly and soon had a full complement of commodity price sections, special index and research units, and an administrative services unit. It also found it necessary to establish regional offices, and, for a time, had some state and district offices. This field organization was required in the main to supervise large-scale surveys and to handle special studies and statistical advisory services required by the Office of Price Administration. Later on special price index work, which the Branch was called upon to do for the Navy and War Departments, was also placed under the general supervision of the Price Analysis Division. For a while this plan of organization for handling the increased work for the war agencies operated very successfully. As the program developed and as greater calls were made upon the data and staff resources of the older Divisions in connection with the Branch's work and for the war agencies, it became clear that a closer integration of this work with the regular program of the Branch was needed. With each Division having its own data-collection and statistical processing staffs, it was not possible to utilize personnel effectively to meet peak loads. Furthermore, the time of the central office professional staff was occupied too greatly with the details of administrative management and it was, therefore, not possible for them to give full attention to the development and direction of the research program in general and to the index work in particular. Likewise, altogether too little attention was being given to other management problems growing out of large-scale operations, such as personnel selection and technical work training, the preparation of annual and special budgets, project cost estimating and cost accounting, work simplification and procedure preparation, work progress reporting, and the analysis and scheduling of the work load.

Organizing on a functional basis.—Faced, therefore, with the problem of improving technical coordination and program management, the Branch decided to functionalize its work. The organizational structure which emerged from this decision is shown in the accompanying chart. Technical coordination was achieved by establishing the position of an



U. S. BUREAU OF LABOR STATISTICS
PRICES AND COST OF LIVING BRANCH
ORGANIZATION CHART
BRANCH CHIEF
SPECIAL CONSULTANTS
OPA LIAISON OFFICER
ASSISTANT BRANCH CHIEF (TECHNICAL COORDINATION)
ASSISTANT BRANCH CHIEF (OPERATIONS)
PROJECT PLANNING & CONTROL STAFF
ADMINISTRATIVE SERVICES UNIT
CONSUMERS PRICES DIVISION
FOOD SECTION
RENT SECTION
APPAREL, TEXTILE, & LEATHER GOODS SECTION
DURABLE GOODS & SERVICES SECTION
COST OF LIVING DIVISION
COST OF LIVING INDEX & ANALYSIS SECTION
INCOME & EXPENDITURES SECTION
COMPARATIVE COST OF BUDGETS SECTION
GENERAL PRICE RESEARCH AND INDEXES DIVISION
PRICE INDEXES SECTION
GENERAL PRICE RESEARCH SECTION
GOVERNMENT PRICES (NAVY DEPARTMENT) SECTION
GOVERNMENT PRICES (WAR DEPARTMENT) SECTION
INDUSTRIAL PRICES DIVISION
METALS & MACHINERY SECTION
LUMBER & BUILDING MATERIALS SECTION
CHEMICALS, FUELS, & MINERALS SECTION
BRANCH REGIONAL OFFICES
BOSTON
NEW YORK
ATLANTA
CLEVELAND
CHICAGO
DALLAS
DENVER
SAN FRANCISCO
BRANCH STATISTICAL SERVICES SECTION
INDUSTRIAL PRICES UNIT
COMMODITIES & FOODS UNIT
RENTS & SPECIAL PROJECTS UNIT
COST OF LIVING UNIT

Assistant Branch Chief to handle difficult technical problems and procedures, particularly those of an inter-divisional character; to serve as expert consultant on broad problems of prices and program policy affecting the work of more than one Division; and, to act as general liaison officer with other agencies on such matters. The program of research work on prices and commodity problems was also strengthened by centralizing all research along commodity lines. This was done by creating two commodity divisions—the Consumers Prices Division and the Industrial Prices Division— in each of which was concentrated full responsibility for all market analysis concerning a given commodity from the wholesale through the retail level. The initiation and construction of index numbers, which cut across commodity and divisional lines, was put into the hands of two groups of specialists—The General Price Research and Indexes Division and the Cost of Living Division. These four Divisions, with the sectional organizations shown under each in the accompanying chart, became responsible for the over-all planning and technical supervision of all of the Branch's activities in their respective fields. This included the work undertaken for the Office of Price Administration and other war agencies, as well as the regular program of the Branch. Because of the large amount and wide variety of statistical work which the Branch is doing for the Office of Price Administration during the war, a special position of OPA Liaison Officer was established to assist in coordinating the work program for that agency. As shown in the chart, provision was also made for special consultants attached to the Branch Chief's Office to advise on specific policy and technical matters.

Under the new plan of organization all program management functions were centralized in a Branch Operations Office under the general supervision of an Assistant Branch Chief for Operations directly responsible to the Branch Chief. The field staffs of the former Price Analysis Division and the field representatives formerly travelling out of Washington were merged into one unit in the Branch Operations Office and were organized under Regional Price Economists responsible to the Assistant Branch Chief for Operations. Likewise, all clerical activities and administrative services were centralized in this Office. The Assistant Branch Chief for Operations was given general authority to act for the Chief of the Branch in the management of the entire work program and full responsibility for the direction of all data-collection and statistical processing operations required by the several Divisions of the Branch. The Assistant Branch Chief for Operations advises the Division Chiefs on the organization of proposed projects and represents the Branch on all project management matters with other agencies for which the Branch performs services. It is also the responsibility of this officer to direct the analysis and scheduling of the

work load and to determine priorities for the performance of all projects in the central office and in the field. He likewise is responsible for supervising the preparation of budgets, project cost estimates, and personnel requirements, and operating procedures.

Inasmuch as the work of the Prices and Cost of Living Branch is an integral part of the Bureau of Labor Statistics it is essential that many of the functions of the Branch Operations Office be performed in close collaboration with the Bureau's Business Management Branch and its general field organization. Experience under the new organization indicates that centralized handling of Branch Operations has facilitated clearances and expedited arrangements with these and other parts of the Bureau and with outside organizations.

How a functionalized statistical organization operates.—The unit of operations and control in the Prices and Cost of Living Branch, under the functional form of organization, is the project. Prior to the beginning of each fiscal year, the various Divisions prepare project proposals, similar to those prepared in budget making, covering their basic program of activities for the ensuing twelve months. Each proposal includes a statement of the purpose of the project, its justification, scope of work, working plans, anticipated results, estimated costs and personnel requirements. The proposal also includes an estimate of the time schedule for the performance of the project. These projects, when taken together, provide the basis for determining over-all staff needs for each of the Divisions and for the various data-collection and data-processing units. Likewise, time schedules and priorities for field work, statistical processing and other operations can be determined for the program as a whole from these project proposals. As new work develops during the year it is also formulated into new or supplementary project proposals and is scheduled for inclusion in the operating plans of the Branch.

Operations under the functionalized organization can be understood best by tracing briefly the course taken by a typical project. For purposes of illustration let us say that the Consumers Prices Division determines that a special survey of food prices at the retail level in selected areas is needed. After proper clearance with the Branch Chief, or Assistant Branch Chief in charge of technical coordination, as to general program policy, the Division Chief directs the Food Section staff to develop technical plans for conducting the study. These plans are formulated into a project proposal which is transmitted to the Branch Operations Office for calculating costs and personnel requirements and for determining the most effective methods of operation. When the proposal has been completed and approved, it is assigned an identification number and is scheduled for operation. The identification number is used by all employees working on the project for pur-

poses of time reporting. When the scheduled time arrives for launching the project, forms, instructions and other materials are transmitted by the Branch Operations Office to the data-collection staff in the field offices and to the Statistical Services Section in Washington. During the course of data-collection and statistical processing work the staff of the Food Section handles all questions of technical procedure by communications to the field offices and the Statistical Services Section transmitted through the Branch Operations Office. When the data have been assembled from the field offices and processed by the Statistical Services Section, they are transmitted in tabular form to the Food Section for analysis and interpretation. Current work progress reports are made by all operating units which show the status of the work on the project at all times and which provide a means of administrative supervision and control. Through the time reports prepared by the staff working on the project and an analysis of non-labor expenditures it is possible to determine periodically the actual cost of the work and to check it with estimated costs. These cost data also become increasingly useful in preparing cost estimates for future projects of the same or similar types.

The foregoing brief account of operations includes only the formal work steps in a functionalized organization. Obviously many decisions on major program and policy questions are arrived at through staff meetings. Frequent informal conferences are also employed in handling day-to-day work problems.

Conditions essential to successful operation.—In conclusion, the experience of the Prices and Cost of Living Branch has indicated certain conditions which are basically essential to successful operations under the functionalized form of organization. Chief among these conditions is general acceptance and consistent observance of the principle of advance planning of all work in terms of specific projects. Related to this and of equal importance is the preparation of and adherence to written operating procedures for all major steps in the performance of the work. Each operating unit must know specifically what it is to do, how the work is to be done, when its part is to be completed, and how the functions it has to perform relate to other units and to the undertaking as a whole. These conditions cannot be achieved without the complete understanding and whole-hearted cooperation of the entire staff. It is essential that the research personnel responsible for developing the program be management-minded, and that those responsible for the operating functions have not only a high degree of skill in administrative management but also possess considerable knowledge of research and statistical methods.

THE SAMPLE CENSUS OF CONGESTED PRODUCTION AREAS*

BY HOWARD G. BRUNSMAN
Bureau of the Census

THE COMMITTEE for Congested Production Areas was established by the President in April 1943. The Committee was instructed to designate congested production areas in order that the successful prosecution of the war could be promoted by providing more effective handling of Federal, state and local problems. Among the most acute problems of these congested production areas are the determination of the needs of the areas for hospital facilities, for butter, for children's underwear, and for a wide variety of other civilian goods. A suitable yardstick is required to measure the needs of each of these areas. Data from the Sixteenth Decennial Census in 1940 have been used for this purpose. These congested areas, however, have shown spectacular increases since 1940 and the census data do not supply a proper measure of the present need. The amount of the particular item that was consumed in a previous period is another possible measure. In many cases these amounts are not available and in those cases where they are available they fail to represent the current needs of the area. The count of applications for ration books in the area has been used to measure demand. The Census Bureau has prepared population estimates for each county of the United States based on these ration book figures. There are differences of opinion concerning the coverage of these data and their comparability with population figures obtained in a census. Because of these differences of opinion they are not always acceptable as measures of the needs of the area. A complete census of the population of the area would answer the questions and would supply a proper yardstick. The manpower shortage in each of these congested areas makes a complete census impractical. After a review of all of the various possibilities, the Committee for Congested Production Areas requested the Bureau of the Census to conduct a sample census in certain designated areas in order to determine the total population and the characteristics of the population of each area. For the purposes of this census the Committee defined each area as a county or as a group of contiguous counties.

Sample surveys are not new. They have been used successfully to

* Presented before the Joint Regional Meeting of the American Statistical Association and the Institute of Mathematical Statistics, Washington, D. C., May 7, 1944, with modifications based on results of the census that became available after May 7.

measure the number of persons employed and the number unemployed in the United States as a whole. All of you are familiar with the results of the survey that is conducted each month by the Special Surveys Division of the Bureau of the Census. Since this survey produces figures for the United States as a whole it is able to take advantage of the total population figure which can be derived from the 1940 population count with adjustments for births, deaths, immigration, and emigration since 1940. The field survey is used primarily to determine the relative number of persons in each of the various labor force groups. Sample surveys also have been used to measure conditions in local areas when the important consideration is the relative number of persons or the relative number of dwelling units with a particular characteristic. The occupancy surveys conducted by Special Surveys Division of the Census Bureau are excellent examples of surveys of this type.

The unique feature of the Sample Census of Congested Production Areas is the requirement that this census measure the total population with a relatively high degree of accuracy for comparatively small areas. In its most elementary terms the procedure which has been developed consists of determining the number of dwelling places in an area, next determining the average population per dwelling place, and then multiplying the number of dwelling places by the average population to secure a total population for the area. The principal steps to be performed under this procedure are: first, the listing of all dwelling places in the area; second, the selection of a sample of these dwelling places for enumeration; third, the enumeration of the selected sample of dwelling places in order to determine the number and characteristics of the population in these selected places; and fourth, the tabulation of the results in order to secure the estimates for the area as a whole.

There are two extremes that might be followed in the listing process. At one extreme, we might list each structure in the area as one dwelling place. On this basis a 300-room hotel and a 500-family apartment building would each be listed as one dwelling place. It might make a considerable difference in the resulting population estimate if a dwelling place of this type were included or excluded from our selected sample. The sampling experts rejected this approach because of the resulting wide variation. At the other extreme, we might list each dwelling unit in the area as a separate dwelling place. In order to be certain that we had skipped none of the dwelling units it would be necessary to knock at each door and determine the exact number of dwelling units located in each structure. This procedure would involve a tremendous amount of work. Ultimately, we decided on a compromise between these two extremes. For purposes of the census a structure that appeared to con-

tain not more than three dwelling units was listed as one dwelling place. Each dwelling unit in a structure containing four or more dwelling units was listed as a separate dwelling place. The listers were able to determine by inspection that most structures did not contain more than three dwelling units and it was necessary to ring very few doorbells in the listing process. Each room in a hotel or in a larger lodginghouse was listed as a separate dwelling place. After the listing process was completed, a sample of the listed dwelling places was selected and indicated on the listing forms. A dwelling unit schedule was prepared for each of these designated units and the dwelling unit schedules were assigned to enumerators for enumeration of all occupants of the designated places.

A special procedure was followed in institutions. The enumerator obtained lists of all occupants of each institution and selected a sample of these occupants for whom he obtained more complete information. The listing and enumeration processes were also combined in the enumeration for trailer camps. This combination was found necessary because of the high mobility of the trailers. If the processes had been separated the enumerator would find that the designated trailers had been moved since the date of the listing.

The sampling experts were faced with the problem of deciding what portion of the listed dwelling places were to be included in the enumeration. It was decided that a sufficiently large group should be enumerated so that the average error in the estimate of the total population of the area would be one per cent. On this basis, there is only a very small probability that the error in the estimate of total population will be as much as two per cent. On the basis of this criteria it was decided that enumeration would be required for one in five of the dwelling places of Charleston, for one in seven in Mobile, one in fourteen in the Hampton Roads area, one in fifteen in the San Diego area, and for one in twenty-three in the Portland-Vancouver area. This sampling procedure yields approximately 8,600 dwelling units in the sample for Charleston and 9,300 in the sample for Portland-Vancouver.

The listing of the 43,000 dwelling places in Charleston cost approximately half as much as the enumeration. The listing of the 210,000 dwelling places in Portland-Vancouver cost twice as much as the enumeration in that area. If all dwelling places in the Los Angeles area had been listed, the listing of the 700,000 dwelling places would have cost twelve times as much as the enumeration. Because of this high listing cost in Los Angeles and in the other large areas, an alternative procedure was developed. As indicated above the listing process serves two purposes; it yields a measure of the total number of dwelling places in the area and it supplies a group from which a representative sample of

the dwelling places may be selected. The sampling experts studied this problem and decided that both of these purposes could be served in the larger area without listing all of the dwelling places in the area. For cities of 50,000 or more the Census Bureau had prepared tabulations of the data obtained in the 1940 Housing Census by city blocks. This tabulation includes the number of dwelling units in each block. Special studies have been made of the change in number of dwelling units in the various blocks of a city. These studies indicate that the most rapid change occurs in the blocks that were vacant at the earlier period. This more rapid change is obvious. The unoccupied land in the vacant blocks offers the greatest chance for expansion. A study of all of these data led to the development of the following procedure: Occupied blocks in cities of 50,000 inhabitants or more were arranged in groups based on number of dwelling units in 1940 and on location of the block within the city as indicated by census tract number. Every *N*th block was selected from the block groups after they had been arranged in this order. Dwelling places located in these selected blocks were listed. The listing process also was performed for all blocks which were vacant in 1940 and for all blocks outside the larger cities for which no 1940 data by blocks were available. After the listing process was completed a sample was drawn from the listed dwelling places. In drawing this sample an allowance was made for the difference in coverage in the occupied blocks of the cities and in the outlying areas. For example, in the Los Angeles area the listing of dwelling places was performed for one-seventh of the blocks that were occupied in 1940 in the larger cities. A sample of one-eleventh of these listed dwelling places was selected for enumeration. For blocks with no dwelling units in 1940 and for areas outside the larger cities all dwelling places were listed and a sample of one-seventy-seventh of the listed dwelling places was selected for enumeration. Thus, the same ultimate sampling ratio of one in seventy-seven was used for all areas in the city.

It is obvious that the estimate of the number of dwelling places in the area based on a selected sample of blocks will not be as accurate as the count of all dwelling places in the area. The resulting error in this estimate is extremely small because of the stratification of the blocks on the basis of the 1940 data and because of the complete listing of dwelling places in the vacant blocks of 1940 and in the outlying areas, where the greatest increase occurred. To offset this error in the estimate of number of dwelling places in the city, we increased the size of the sample of dwelling places selected for enumeration. Thus, the less accurate measure of the number of dwelling places in the area multiplied by the more accurate measure of population per dwelling place

leads to a measure of total population of the same accuracy as would be obtained with complete listing of all dwelling places and the enumeration of a smaller sample of the listed places. The increased sample included in the enumeration resulted in a total of 9,700 dwelling units for the enumeration of the Seattle area, ranging to 17,000 for the San Francisco area.

The main objective of the sample census is the establishment of an accurate population estimate for each area as a whole. This population figure should be comparable with the 1940 population figure. At the same time it must be recognized that these areas now contain a large number of visitors who would not be counted in the population of the area if we used the 1940 approach. These visitors include families of soldiers and sailors and other persons who are in the area only temporarily. To get complete coverage we instructed the enumerators to include anyone whose usual place of residence was in the selected dwelling place and anyone who slept in the dwelling place during the last twenty-four hours. By means of supplementary questions we determined which of these persons were residents of the area and which were visitors and also which of the persons were present during the past twenty-four hours and which of the usual residents were absent.

A "household" type of schedule was used in the enumeration process. Characteristics of the dwelling unit as a whole are shown in the heading of the schedule. Data relating to each individual in the dwelling unit are shown on a separate line in the body of the schedule. Extra dwelling unit schedules are used when an assigned dwelling place contains two or more dwelling units. This type of schedule is particularly well adapted to the census because of our method of assigning dwelling units for enumeration. The standard basic population data are obtained for each person enumerated in the census. These data include relationship to head, sex, color, age and marital status.

There is considerable interest in the extent of migration into these congested areas. Few data regarding this migration are now available. In order to throw additional light on this subject, the schedule includes a series of questions relating to place of residence of each person on April 1, 1940. The series of questions includes the name of the state in which the person lived in 1940. If the person lived in the same state in 1940 and in 1944, he was asked to report his county of residence in 1940. On the basis of this additional question we are able to identify those persons who moved into this congested area from elsewhere within the state since 1940. In order to determine the extent of migration from farms into the area a question is included on whether or not the person lived on a farm on April 1, 1940.

The schedule also includes a series of questions relating to the labor force status of each person 14 years old and over. The labor force questions utilize the so-called "sifter" approach that was used in the 1940 population census and which is now being used in the Monthly Report of the Labor Force. For each person 14 years old and over the enumerator was instructed to ask "Were you at work for pay or profit last week?" If the answer to this question is "No," ask "Were you seeking work last week?" And if the answer to this second question also is "No," ask the reason for not seeking work. Five general reasons for not seeking work are specified, as follows: (1) Had a job or business but not at work because of vacation, temporary layoff, temporary illness, or other similar reason, (2) Permanently unable to work or too old to work, and (3) Attending school and without a job, (4) Engaged in housework at home, and (5) Not seeking work for other reasons such as retired, or voluntarily idle.

The results for five of the areas are now available. These results show a resident civilian population of 3,357,000 in the Los Angeles area, representing a 15 per cent increase over the population on April 1, 1940. The 1944 population of 1,841,000 in the San Francisco Bay area represents a 26 per cent increase over 1940, the 167,000 of the Charleston area is a 38 per cent increase, the 416,000 of the San Diego area is a 44 per cent increase, and the 234,000 of the Mobile area represents a 65 per cent increase. The separate figures for the parts of these areas show a consistent pattern of greatest relative increase in the part of the metropolitan district that is outside the central city of the area, and smallest increase in the part of the area that lies beyond the boundaries of the metropolitan district, with the increase of the central city ranging between these two figures. The only exception to this pattern is the large relative increase in the small portion of the Los Angeles Congested Production Area that is located outside the metropolitan district.

The part of the resident population which was reported to be absent at the time of enumeration ranged from less than 1 per cent of the total resident population of the Mobile area to 2 per cent of the San Diego area. Visitors in the areas represented less than 2 per cent of the population present in the Charleston area, and ranged to a high of nearly 3½ per cent in the San Diego area. Thus, the population present in each of the areas exceeded the total resident population, the excess ranging from less than 1 per cent to nearly 1½ per cent. It should be noted that all published figures exclude several groups that account for a substantial portion of the congestion in these selected areas. Among the largest of these excluded groups is the Army and Navy per-

sonnel living on military posts and members of the Merchant Marine living on vessels in the area. The published figures do not include persons working in the area but sleeping outside the area. Nor do they include the daytime visitors from outside the county who were in the area on shopping trips or personal business.

In addition to the five areas specified above the census will include the Portland-Vancouver, Puget Sound, Hampton Roads, Detroit-Willow Run, and Muskegon areas. The census is being conducted on a sample basis in all of these areas except the Muskegon area where a complete enumeration is being used because of the relatively small number of inhabitants.

The results of the census of the Mobile area give some indication of the types of information that may be obtained from the analytical tables. Since April 1, 1940, the white population of the area increased 88 per cent, as compared with an increase of only 25 per cent in the nonwhite population.

The number of children under 5 years of age in the Mobile area in 1944 was more than double the number of children of this age in 1940. In contrast, the number of males between 20 and 24 years of age increased only 18 per cent during this period. There were 12,537 more females than males in the area in 1944. This represents a ratio of 90 males to 100 females, as compared with a ratio of 94 males to 100 females in 1940. The change in the ratio of males to females for the area is most noticeable in the military age groups. For example, in the group 20 to 24 years old the 1944 ratio is 47 males to 100 females, as compared with a ratio of 86 males to 100 females for this age group in 1940.

The influx of workers seeking employment in Mobile shipyards and other war industries has almost doubled the area's labor supply. In the Mobile metropolitan district among the women 18 to 64 years old and over who had no children under 10 years old, the proportion in the labor force increased from 44 per cent in 1940 to 51 per cent in 1944. In contrast, for women with children under 10 years old the proportion in the labor force showed a decline from 17 per cent in 1940 to 15 per cent in 1944.

Migration into the Mobile area from other parts of the United States was responsible for practically all of the population increase since 1940. The excess of births over deaths has been almost entirely canceled by the induction of men into the armed forces during this period. At least one person out of every three living in the county in March 1944, had moved in since April 1, 1940. Most of the in-migrants came from nearby areas; 46.1 per cent came from other counties of Alabama, 46.4 per cent from other states in the South, and only 7.5

per cent from states in the North and West and from foreign countries. A little over one-fourth of the in-migrants reported that they lived on a farm in 1940.

The in-migrants differed considerably in their characteristics from the people who lived in the area before the war. Only one-seventh of the in-migrants were nonwhite, as compared with more than one-third of the nonmigrant population. On the other hand, in-migrants, who were divided about equally between males and females, helped to bring the ratio of the sexes more nearly into balance. The percentage who were married was about the same in the in-migrant as in the nonmigrant population 15 years old and over. Among the married men in the in-migrant group, however, 20 per cent were not living with their wives in contrast with only 6 per cent of the nonmigrant married men. While a great majority of the in-migrants had established separate living quarters, 13.6 per cent were lodgers living with private families and 6.6 per cent were living in lodginghouses, hotels, dormitory rooms, or institutions.

The number of occupied dwelling units in the Mobile area increased 59.1 per cent between April 1, 1940, and March 1944, as compared with the increase of 64.7 per cent in population; the lodger population and the number of subfamilies in the area showed a considerable increase.

The results of the census will provide similar information for each of the ten congested production areas. The complete set of materials will include a relatively extensive series of analytical tables for each of the areas. These ten congested production areas comprise 28 counties, and five independent cities. They contain more than 28,000 square miles and have an estimated population of more than ten million.

ANALYSIS OF THE DATA OF A PUBLIC HEALTH ORGANIZATION BY THE CONTROL CHART METHOD*

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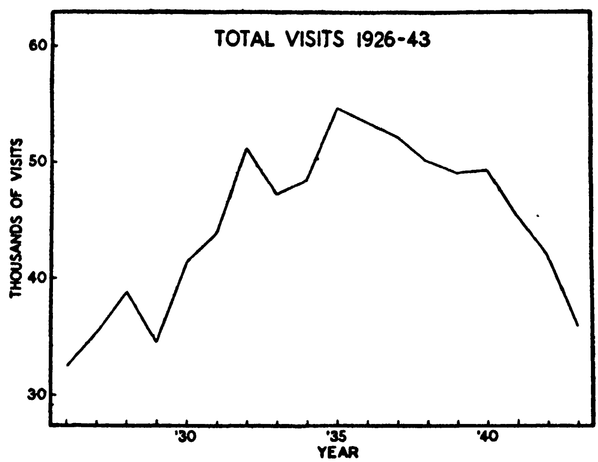
INTRODUCTION

THE VISITING Nurse Association of San Francisco is a corporate member of the National Organization of Public Health Nurses. Its activities include general and maternity nursing on a part time basis, prenatal classes and health supervision. In addition, services are available to industrial policy-holders of certain insurance companies without extra charge. The organization is a member of the Community Chest.

CHART I



Data showing the number of visits made by the Association each year are shown in Chart I. There is an obvious decline after the year 1935. The purpose of this paper is to discover the causes; also to describe the method used for analysis. The method is not hard to learn and undoubtedly has wide applicability in similar problems.

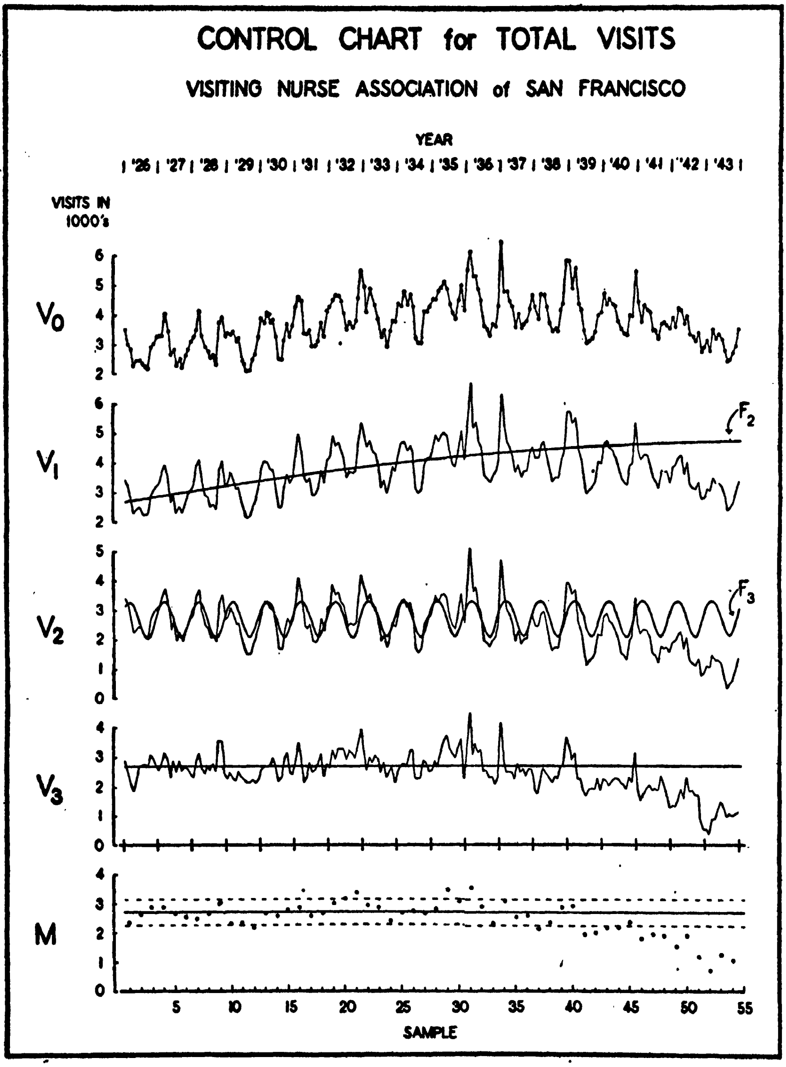
THE CONTROL CHART METHOD

As applied in industry, the method of quality control is designed to achieve a uniform result by discovering the causes of variation [1]. The

* I am indebted to the Secretary of the Visiting Nurse Association of San Francisco, Miss Aileen O'Brien, for aid in compiling these data, and to the Board of Directors for permission to publish them.

method was developed by Shewhart [2], [3], Deming [4], Simon [5] and others, primarily for the control of the quality of manufactured

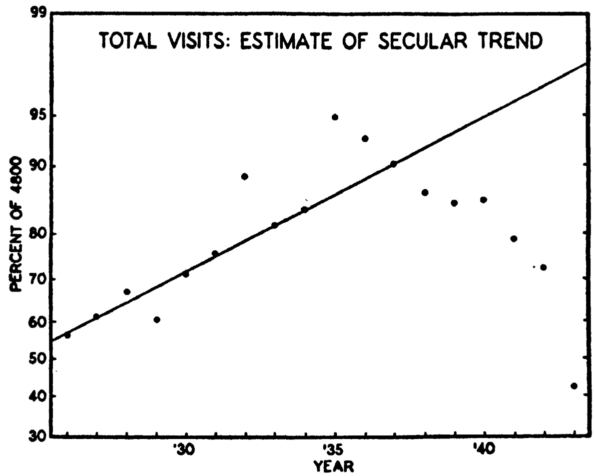
CHART II



products, and Rich [6] has recently used it in an analysis of the Columbia River salmon catch, as "it provides a convenient and rapid way of discovering the presence of heterogeneity in data, the causes of which on further study may be identified."

The ultimate purpose of such an analysis is action [7]. From the evidence presented by the data, standards are set up with which to determine the randomness of the process[1] under consideration. Deviations exceeding these standards, or "control limits," are then not the result of chance effects; they are not random, but originate in factors to which specific causes may be assigned. In the immediate problem, some changes in the number of visits may have their genesis in causes beyond the control of the organization, in which case no corrective action is possible. Other changes, however, may originate in disturbances of intra-organizational administration, for which the cause is then sought and, if discovered, action can be taken by the application of the appropriate remedy. If the diagnosis has been correctly made, and the proper counter-measures instituted, succeeding deviations will remain within the limits set, that is, they will show the existence of a state of control.

CHART III



PRELIMINARY ADJUSTMENT OF THE DATA

The raw data, total visits per month, are shown in Chart II, panel V_0. These are adjusted (F_1) to an average month of 30.42 days, the corrected values being plotted in panel V_1. Inspection of this panel indicates the influence of two additional factors, i.e., secular trend and seasonal variation. Both lend themselves to mathematical expression; their effects therefore may be removed from the data.

Correction for secular trend.—The trend is determined by making use

[1] For the purpose of this particular inquiry, "process" refers to the operational stability of the organisation, measured in units of monthly visits.

of arithmetic probability paper [8]. The straight line fit (upper asymptote = 4800) is shown in Chart III. Eight of the first 12 points fall very nearly on the line. The remaining 4 can be disregarded, as the deviations which they show are the direct result of known economic factors which are not a part of the general trend, and which will be referred to later. The theoretical increase in monthly visits due to secular growth is shown as F_2 in panel V_1. The subtraction of these values results in panel V_2.

Correction for seasonal variation.—The cyclical movement remaining in panel V_2 is of the sine-cosine type. A standard cycle is calculated on the basis of the first 10 years according to the formula [9].

$$Y_c = \bar{Y} + A \sin\ [(360/T)X]^\circ + B \cos\ [(360/T)X]^\circ \qquad (1)$$

where

$$\begin{aligned} X &= \text{successive months of a cycle, i.e., 1–12} \\ \bar{Y} &= \Sigma(Y)/12 = 2732 \\ &\quad Y \text{ is a specific monthly average over 10 years} \\ T &= \text{length of cycle, in months} = 12 \\ A &= (2/T)\Sigma\{Y \sin\ [(360/T)X]^\circ\} \\ B &= (2/T)\Sigma\{Y \cos\ [(360/T)X]^\circ\}. \end{aligned}$$

This works out to

$$Y_c = 2732 + 578.8 \sin (30X)^\circ + 272.50 \cos (30X)^\circ.$$

The calculated values are plotted as F_3 in Chart II, panel V_2. The necessary subtractions are made, and the residuals, now freed from the effects of three known causes of variation, appear in panel V_3 in proper form for the application of the control chart method.

APPLICATION OF THE CONTROL CHART METHOD[2]

The symbol X is used to indicate an observed value. Specific observed values, i.e., the number of visits in each month, are designated $X_1, X_2, \cdots, X_n$, where n is the number of observed values in a sample. As each of our samples includes the data for 4 months, $n=4$, any sample mean then may be written

$$\bar{X} = (X_1 + X_2 + X_3 + X_4)/n.$$

Thus the mean of sample 1 is

[2] For a detailed exposition, reference should be made to the publications of the American Standards Association [10], [11], [12].

$$\bar{X}_1 = (2912 + 2595 + 2158 + 1866)/4$$
$$= 9531/4 = 2383.$$

R is the range, the difference between the largest and the smallest observed value in a sample of n values. Thus

$$R_1 = 2912 - 1866 = 1046.$$

$\bar{\bar{X}}$ and $\bar{R}$ are the averages of a set of values of $\bar{X}$ or R.

The choices of the fundamental charts and subgroups of this study were somewhat forced by the manner in which the records were originally kept, units of one month being the smallest available. There is no reason, of course, why different choices should not be made in other investigations.

First analysis: total visits.—The mean and the range of each successive sample are calculated and the former plotted in Chart II, panel M. The ranges are not plotted, experience having shown that instances of lack of control in this study are always associated with causes that affect $\bar{X}$ rather than R. The mean range, $\bar{R}$, must be calculated, however, to provide a basis for computing the control limits of $\bar{X}$.

Inspection of the data indicates the advisability of using the first 10-year period (1926–35) for the determination of preliminary standards, on the basis of successive samples of 4 months each. Thus $\bar{\bar{X}} = 2723.7$ is the mean of the first 30 sample means, and $\bar{R} = 612.7$ is the mean of the corresponding ranges. A line is drawn in panel M over the period covered to indicate the level of $\bar{\bar{X}}$. The limits to be calculated represent two values of the variable, one above and the other below the grand mean, between which, under constant conditions, all of the sample means will fall *if* a state of control exists. Variations within the limits may be assumed to be due to "errors of random sampling." Points falling outside, however, in either direction would not result by chance oftener than about three times in a thousand observations, and hence may fairly be suspected of having assignable causes. Can such causes be determined, and are means at hand for taking corrective action?

Deviations above the upper control limit, representing an increased number of visits, may always be explained on the basis of unseasonable epidemics, increased relief work due to economic factors, etc. They only indicate that the activities of the organization were increased above the normal level, and thus give no occasion for action. We are more concerned with sample values falling below the lower limit, each of which demands explanation or action, or both. If explainable, and the cause is found to be beyond the control of the organization, it is enough to have attention called to the fact. However, lacking an ex-

planation based on an uncontrollable cause, trouble *within* the organization is indicated, and prompt investigation should be instituted. The purpose of the control chart, then, as applied to these data, is directed primarily toward the discovery of low values, thus samples exceeding the upper limit may, in general, be disregarded.

The preliminary estimate of the control limits are now made, following the procedure outlined in references [10], [11], and [12], q.v. As $n=4$, the following factors apply:

$$A = 1.500$$
$$A_2 = 0.729$$
$$d_2 = 2.059$$

and from these, the

$$\begin{aligned}\text{Control limits for } \overline{X} &= \overline{\overline{X}} \pm A_2\overline{R}\\ &= 2723.7 \pm 0.729 \times 612.7\\ &= 2723.7 \pm 446.7\\ &= 3170 \text{ and } 2277\end{aligned}$$

the level of the last values being shown as broken lines in panel M for the period 1926–35.

Do these preliminary standards properly represent the data? Three sample means fall outside the limits, but it is possible to assign uncontrollable causes to each. Sample 12 (1929.3) reflects[3] a decrease and 21 (1932.3) an increase in the number of free cases handled for the Community Chest, while 29 (1935.2) corresponds to a marked increase in visits originating in the state and federal emergency relief administrations. It would actually make no great difference whether these samples were disregarded or not, yet it was decided to discard them and to calculate new values for $\overline{\overline{X}}$ and $\overline{R}$. Now

$$\overline{\overline{X}} = 2695.2$$
$$\overline{R} = 618.8$$
$$\sigma' = \overline{R}/d_2 = 618.8/2.059 = 300.5$$

the last value being the calculated standard deviation of the universe sampled. On the basis of the standard values just adopted, the

$$\text{Central line for } \overline{X} \text{ is } \overline{X}' = \overline{\overline{X}} = 2695.2$$
$$\text{Control limits for } \overline{X} \text{ are } \overline{X}' \pm A\sigma'$$

[3] The figures in parentheses indicate the year and the third.

$$= 2695.2 \pm 1.500 \times 300.5$$
$$= 3146 \text{ and } 2244.$$

These now represent the final control limits for the sample means. The lines are transferred, as before, to panel M to cover a suitable future period beyond that of the preliminary data, i.e., starting with January 1936.

Inspection of panel M now shows that (a) sample 37 (1938.1), and (b) all the samples but one following 40 (1939.1) are out of control. The former gives a remarkable illustration of the sensitivity of this kind of analysis, when it is recognized that the assignable cause associated with this sample (which has been confirmed) was the failure of certain of the usual spring epidemics to make their appearance. This is indicated by the marked divergence of the monthly visits from the sine curve at this point (see panel V_2). The sequence following sample 40, however, shows such an increasing lack of control that the explanation must lie either in disturbances of internal organization or in external factors, or both.

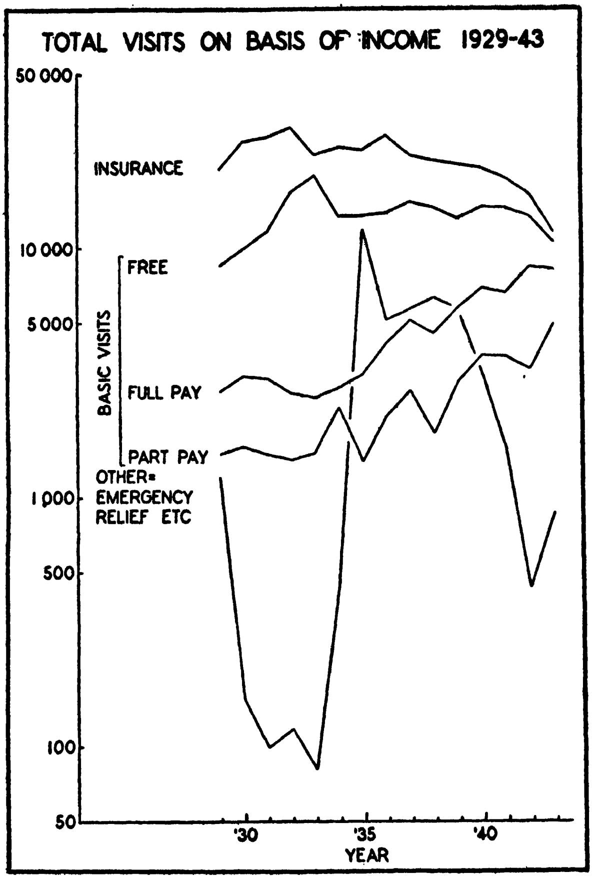
It should be noted here that panel M suggests a resemblance of cycles, but in general these remain within the limits of randomness. It is not surprising to find such an appearance, and its cause, as yet undetermined, is inherent in the residuals of the data and may well represent the effects of uncontrollable factors. A more detailed discussion will be given subsequently.

No explanation for the lack of control following sample 40 was disclosed, suggesting that the data were inadequate for the discovery of specific causes. Thus, to gain information, the monthly visits were broken down into a number of categories, based on source of pay. This disclosed two principal groups: (1) Basic, i.e., free (Community Chest etc.), part-pay and full pay; and (2) Contract, i.e., visits referred by insurance companies and by the state and federal relief agencies on a stated cost basis. The details are plotted in Chart IV. It will be seen at once that there was a steady decrease in insurance cases since 1937, due primarily to restrictions by one large company, while at the same time there was a great reduction in visits handled for the emergency relief administrations. The decrease in contract business clearly indicates one cause, at least, for the lack of control so far exhibited. As the acquisition of such business cannot be regulated by the Association, the monthly visits were recalculated on the more rational classification of basic visits alone.

Second analysis: basic visits.—Figures were not available, properly classified, prior to 1929. The revised data are charted in Chart V, which

follows the plan already given for Chart II. After correction to an average month (F_1), secular trend is recalculated on the basis of an assumed upper asymptote of 3000. The plot is shown in Chart VI, the

CHART IV



first three points representing the best estimates for the missing values. The fit is good when disregarding those deviations known not to be a part of the general trend, i.e., 1929, 1932–33. The correction for seasonal variation is applied, Formula (1) working out to give

$$Y_c = 1035.0 + 150.2 \sin (30X)^\circ + 50.8 \cos (30X)^\circ.$$

The averages and the ranges of the first 10-year period now give

$$\bar{\bar{X}} = 1035.0$$

$$\bar{R} = 239.5$$

and, as the sample size remains 4, the A and d constants are unchanged. Thus, the

$$\begin{aligned}\text{Control limits for } \overline{X} &= \overline{\overline{X}} \pm A_2\overline{R} \\ &= 1035.0 \pm 0.729 \times 239.5 \\ &= 1035.0 \pm 174.6 \\ &= 1210 \text{ and } 860.\end{aligned}$$

Lines representing these values appear in Chart V, panel M, to cover the period 1929–38; and it is apparent that 9 points now lie outside the preliminary limits. All of them were omitted in the calculation of the final standards, for (a) samples 20–23 represent greatly increased free work reflecting the depression (1932–33), (b) the low value for sample 28 (1935.1) is the result of a sharp decrease in part-pay visits which may be interpreted as an "offset" to the great increase in emergency relief during this year, and (c) the remaining 4 samples are only marginally out of control. The new values are

$$\begin{aligned}\overline{\overline{X}} &= 1002.4 \\ \overline{R} &= 255.1 \\ \sigma' &= 123.9.\end{aligned}$$

On the basis of the standard values just adopted, the

$$\text{Central line for } \overline{X} \text{ is } \overline{X}' = \overline{\overline{X}} = 1002.4.$$

The control limits for $\overline{X}$ are

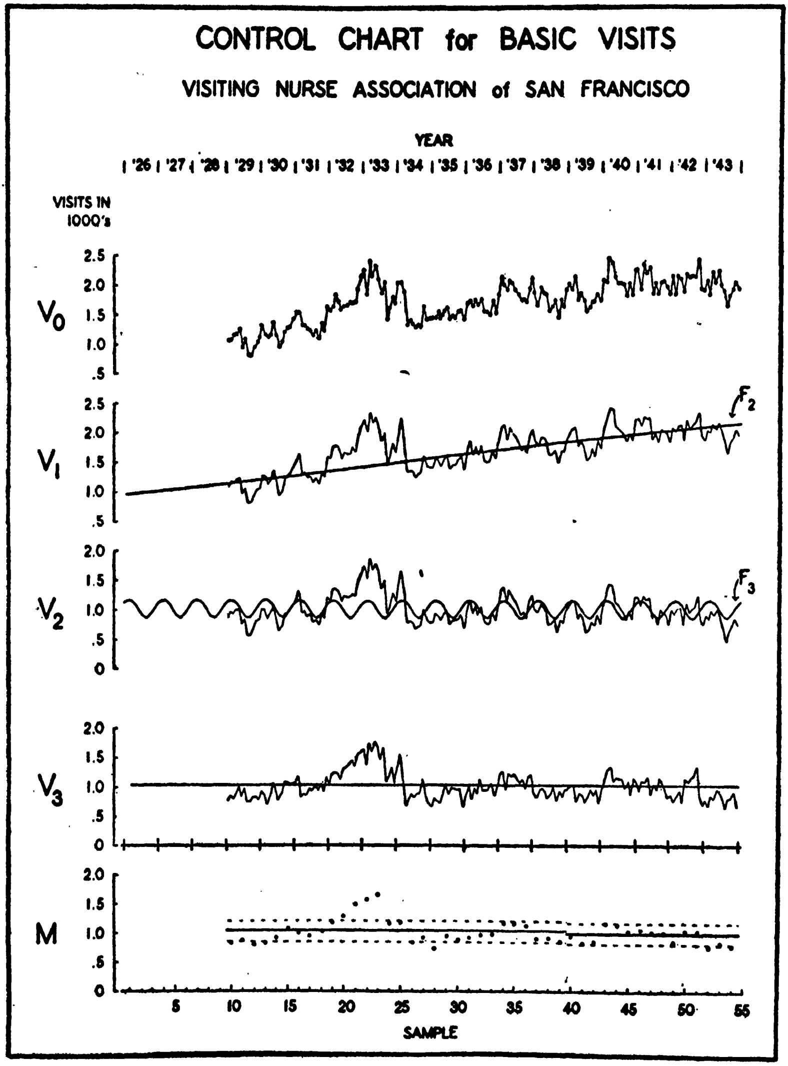
$$\begin{aligned}\overline{X}' \pm A\sigma' &= 1002.4 \pm 1.500 \times 123.9 \\ &= 1002.4 \pm 185.8 \\ &= 1188 \text{ and } 817.\end{aligned}$$

The central line, with its limits, is now transferred to Chart V, panel M to cover a period beyond that of the preliminary data, and, with the exception of two samples, both occurring in 1943, the "process" is shown to have been in a state of control. This justifies the division of the data into two groups, and shows that the decrease in total visits was due to a reduction of contract business.

It is necessary, however, to assign a cause, or causes, for the low values of samples 52 (1943.1) and 54 (1943.3). The deterioration was due to several factors. Because of the war, the year was marked not only by an excessive staff turnover, but by an actual shortage of nurses. This condition was aggravated toward the end of the year, when the pre-

vailing influenza epidemic affected the personnel as well as the public. Thus, the educational work of the organization was reduced, and, as

CHART V



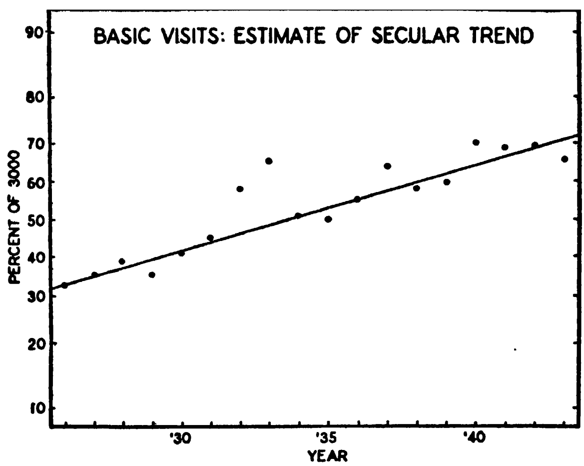
there is a direct relationship between such work and free visits, these decreased. Furthermore, because of the illness of the staff, the follow-up work also decreased, particularly during December. It may therefore be concluded, after taking into account the effects of the known causes

of variation on basic visits, and considering also the impact of a war economy on the organization, that the internal condition of the Association is sound.

DISCUSSION

The efficiency of the control chart as applied to the analysis of these data has been demonstrated. It remains, however, to refer again to the suggestion of cycles in the residuals (see panel *M* of Charts II and V). It was pointed out that while, in general, these remained within the

CHART VI



limits of randomness, they might represent the influence of uncontrollable factors. Reference is now made to the residuals in Chart V. While their cyclic character is not as marked as those in Chart II, there appear to be certain trends. Specifically, their direction and duration are thus:

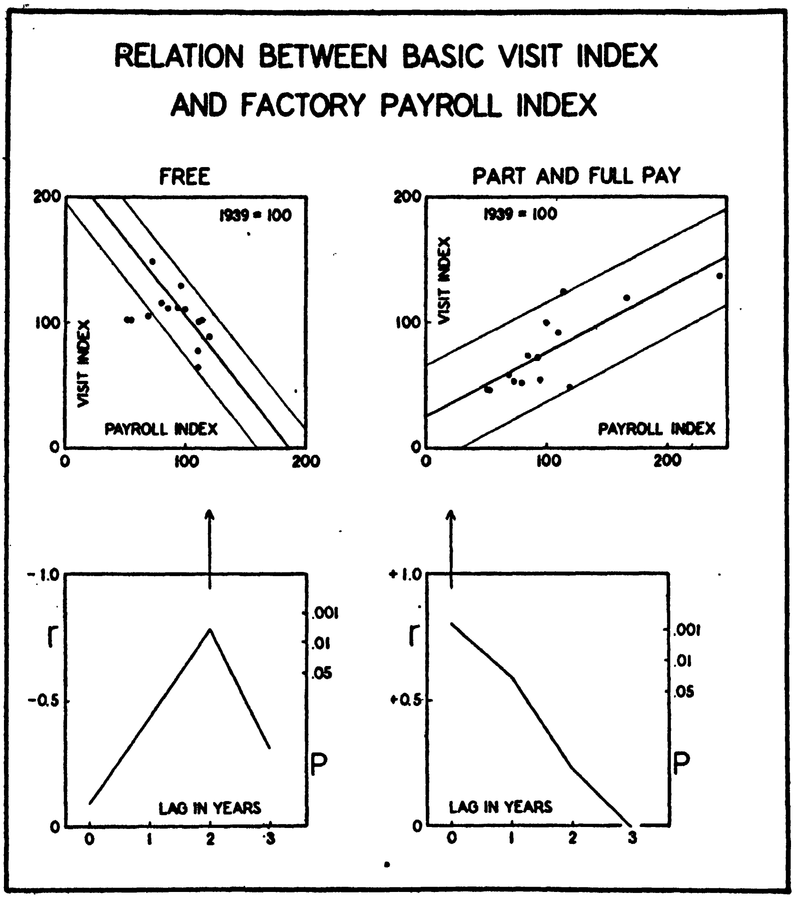
Upward: 1929–33; 1935–37; 1939–40

Downward: 1933–35; 1937–39; 1940–43.

It is generally recognized that an organization such as this is highly sensitive to changes in general economic conditions. In theory, a depression should result in an increase in free visits with a corresponding decrease in income-producing business. The reverse should hold true on the return of prosperity. In order to test this theory, which would explain part, at least, of the apparent residual cycles, use was made of the annual factory payroll index (1939 = 100) of the Federal Reserve

System [13]. It is not an ideal measure for the purpose, but has the advantage of continuity over the period covered by the data. An annual basic visit index with the same point of reference was prepared, and a

CHART VII



Regression lines with 95 per cent limits. Open circles in upper left panel represent abnormally low values due to government relief programs (1934–36) and are omitted from the calculations. r is the correlation between visit index and payroll index. P is the probability associated with r.

series of correlation coefficients calculated in order to discover (a) association between the two variables, and (b) the time lag intervening before changes in economic conditions were reflected in the business of the Association. The results are tabulated below, and are also shown in Chart VII.

Lag in years	Correlation coefficients (r)	
	Free visits	Part and full-pay visits
0	−.0893	+.8021
1	−.4278	+.5930
2	−.7828	+.2313
3	−.3148	−.0201

Chart VII appears to bear out the theory put forward. It is noteworthy that a lag of two years occurs before the maximum effect of a depressed economy makes itself felt in an increase in free business. Income-producing business, however, tends to decrease immediately as the payroll index falls.

The apparent cycles in the residuals are thus accounted for, and it should be pointed out as well, that the consecutive sequences of points above and below the averages in the *M* panels of Charts II and V, probably have the same assignable cause. Unfortunately it is not feasible to correct for this source of variation, as a correction cannot be applied to current data. Its importance lies in its effects on past performance, which make it possible to prognosticate the future with a greater degree of assurance. Thus, on the basis of experience, it would not be surprising to find a still greater decrease in free visits while the war lasts, the factory payroll index currently showing a marked upward trend. Income-producing business might compensate for this decline, but it must be taken into consideration that many of the income-producing patients are employed by the Federal Government and by the local shipyards, and are thus eligible for free nursing care elsewhere.

CONCLUSIONS

1. There has been a decline in the total business of the Visiting Nurse Association of San Francisco since 1935.

2. The decrease is due to a reduction in the number of contract cases handled, for

3. On removal of this segment from the data, it is shown that successive samples of four months each now either (a) remain in a state of control, or (b) have assignable causes beyond the control of the organization.

4. The activities of the organization are sensitive to changes in general economic conditions.

5. So far as its basic function is concerned, the Association is operating in a satisfactory manner.

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[10] American Standards Association: "Guide for Quality Control." Z1.1–1941, American Standards Association, 29 West 39th St., New York 18.

[11] American Standards Association: "Control Chart Method of Analyzing Data." Z1.2–1941, American Standards Association, 29 West 38th St., New York 18.

[12] American Standards Association: "Control Chart Method of Controlling Quality During Production." Z1.3–1942, American Standards Association, 29 West 39th St., New York 18.

[13] Board of Governors of the Federal Reserve System: *Federal Reserve Bulletin.* Washington, November 1943.

MATTERS OF MISCONCEPTION CONCERNING THE QUALITY CONTROL CHART

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During the early days of the war, the tank armor program was expanding rapidly. A combination of circumstances made it evident that a reduction in the amount of armor consumed by acceptance testing (which is necessarily destructive) would soon be necessary. The problem was to develop a sound basis for reducing the amount required from any given facility.

To provide such a basis, the Armor Plate Quality Control Plan was developed and put into operation by the Ordnance Department. The Plan is based upon the quality control chart for variables using averages and ranges for groups of four successive ballistic test results.

There are generally a great many practical considerations involved in connection with the application of a quality control chart to an industrial process and it is especially so in this case. Hence, a discussion of the Plan is beyond the scope of this paper.

The application here used has been comparatively new to a large portion of the people affected. As a result, a number of practical questions have been raised with reference to the suitability of the application and the interpretation of the quality control charts constructed. It will be the purpose of this paper to discuss some of the matters most commonly mentioned.

1. *There are too many variables in the manufacturing process.* Any process designed to produce successive items, all of which are intended to be essentially alike with respect to certain measurable quality characteristics, will involve a certain number of variables. As a normal minimum there will be at least four major variables—raw materials, process variations, personnel and extraneous factors such as weather, atmospheric conditions, breakdowns and power failures. Each of these major variables may in turn be broken down into as many subdivisions as the product involves.

For a comparatively simple process, the problem of determining the importance of each variable is not too difficult. As the process grows more complex, the need for statistical methods to evaluate the significance of results increases. In any case, statistical methods are invaluable in distinguishing among border line cases where the significance of obtained differences is not obvious.

In the application involved here, the objective is to make many pieces of armor at a satisfactory quality level, with all of the pieces being essentially alike. This is the very thing the quality control chart is designed to measure. Therefore, the number of variables in the manufacturing process is of no concern with respect to the suitability of the quality control chart for this purpose.

2. *There are too many changes made in the process from time to time.* Change in material things inheres in the fact that the minute particles that make up all matter are in constant motion and are subject to constantly shifting intra- and inter-atomic forces. The changes that occur in the material world vary all the way from the spectacular changes that occur in a fraction of a second to the virtually imperceptible ones that require many years for completion. The important thing is that with time, all material things change.

Efforts to establish a manufacturing process that will produce successive items all identically alike are futile. The possibility of two or more things exactly alike exists only in the mind as a concept and has no verification in human experience. Even if the portions of raw materials were identical, we would be defeated by the fact that the manufacturing equipment is subject to constant change. Friction, temperature fluctuations, and other constantly shifting chemical and physical forces continually alter the machinery used. The net result is that no two items ever come from identically the same process.

With sufficiently homogeneous raw materials and proper engineering design, it is usually possible to produce successive items that are nearly enough alike to function satisfactorily for the purpose intended. When such items are produced under the condition of statistical quality control, no further reduction in the amount of variability inherent in the process can be achieved unless fundamental changes are made in the nature of the raw materials or in the process. When operations are proceeding in this manner, the changes occurring in the process (whether readily detectable or not) are unimportant. When changes occur that significantly shift the quality level or variability of the product, this fact will promptly reveal itself on the control chart.

3. *The sample is not sufficiently representative of the lot.* It is generally agreed that sometimes the test plate does not properly represent part or all of the lot from which it comes. Therefore, the point of view of the Armor Plate Quality Control Program is that the test plate does not adequately represent the lot. It does represent the production process and enables us to determine whether the process is in control. When it is not in control, the likelihood of substandard material being made is

greatly increased. At such times it is highly desirable to increase the amount of testing done.

4. *The test method is not precise enough.* Methods of testing vary considerably in their precision. Unfortunately, the methods of testing the ballistic quality of armor are not as precise as we should like. However, the test methods used do enable us to distinguish various quality levels of armor. Further, they are considered suitable as a basis for acceptance and rejection. In general, we may state that any test method that is considered good enough to form a basis for acceptance or rejection of the material tested is suitable for application of the quality control chart.

5. *The method has never before been used for this application. How do we know it will work?* The point has been raised that the quality control chart technique has been in use only since 1924 and that this is the first time it has been applied in this manner to armor plate. After all, how are we sure its application here is sound? The answer to this question lies in the function of the quality control chart. That function is to measure the degree and sort of control existing in a repetitive process designed to produce successive items all essentially alike. Therefore, the mere fact that a specific application has not been made before need not be a matter of concern. The nineteen years the method has been in use have been far more than enough to establish its validity and reliability. They were established virtually from the beginning.

6. *With time, my ranges will decrease and I will eventually be forced out of control.* When production is begun on a new product, it is generally expected that some production difficulties will occur that will be cleared up as time goes on. It is also expected that some way may be found to improve the quality level of the product and to improve its uniformity. When a large number of manufacturers are all making the same sort of new product, it would be most surprising if some of them did not succeed in making this improvement. In line with these expectations, some armor manufacturers have succeeded in raising their ballistic quality level or reducing their variability to as much as about two-thirds of its original value.

As ways are found to improve the product, the production job may become more difficult. However, when a new level of quality or reduced variability has been established, the probability that a point will fall outside the new control limits just due to chance is the same as it was before. There never will come a time when the manufacturer will of necessity fall out of control just because he is making an improved product.

It is natural for the manufacturer to desire tolerance limits as wide as possible. This tends to make his job easier. The way to better quality, however, requires something more than mere maintenance of existing standards or close adherence to minimum standards of acceptance. Efforts to obtain wider control limits through the deliberate introduction of greater variability into the product are to be strictly avoided. The lack of randomness almost certain to be associated with such efforts will quickly reveal itself as a lack of control. In any event, the task will undoubtedly prove to be more laborious and costly than any so-called advantage obtained would justify.

In order to illustrate the relationship between changes in the cause system and quality control chart shifts in quality level and variability, three charts have been constructed using random numbers. A series of random numbers consists of digits so selected that each time one is chosen, one digit is just as apt to occur as any other digit (insofar as it is humanly possible to create this condition). The following is a series of 50 such numbers:

0 9 1 1 5 1 8 6 3 5 1 2 2 5 3 7 5 9 1 3 6 7 2 0 2

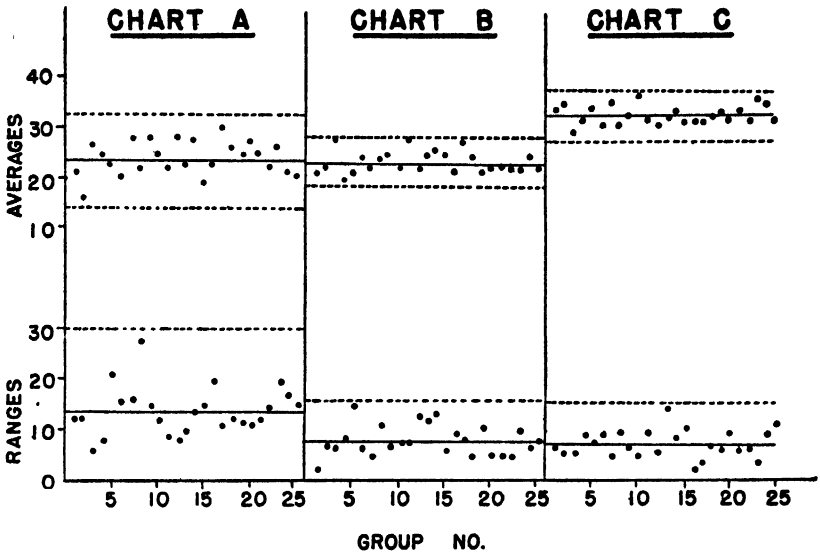
1 1 3 3 3 6 1 6 2 6 0 0 6 2 1 1 9 4 6 9 3 8 0 8 9.

Each five successive numbers were added together. The maximum possible number that could be thus obtained would be 45 (five 9's) and the minimum would be 0 (five 0's). These newly obtained numbers tend to closely approximate the normal distribution. One hundred numbers were accumulated in this manner. They were then grouped by successive four's and the average and range of each group of four determined. The expected grand average would be 22.5. Control chart limits were then calculated for the 25 groups in a manner similar to that used in the Armor Plate Quality Control Plan. The results are shown as Chart A.

The entire process was then repeated after all 0's, 1's, 8's and 9's had been removed from the original list of random numbers. The maximum number now obtainable would be 35 (five 7's) and the minimum would be 10 (five 2's). The expected grand average would still be 22.5 but the average range would be expected to be considerably smaller thus bringing the control chart limits on the chart for averages much closer together. The results are shown as Chart B.

The entire process was again repeated with only the 0's, 1's, 2's, and 3's removed from the original list of random numbers. The maximum number now obtainable would be 45 (five 9's) and the minimum would be 20 (five 4's). The expected grand average would now be 32.5 and

the average range would be expected to be virtually the same as that for Chart B. The results are shown as Chart C.



Calculated results:	Chart A	Chart B	Chart C
Grand average	22.83	22.69	32.29
Upper control limit	32.31	27.76	37.13
Lower control limit	13.35	17.62	27.45
Average range	13.00	6.96	6.64
Upper control limit	29.67	15.88	15.15
Lower control limit	0	0	0

The important thing to note in connection with the above charts is the fact that when significant shifts occurred in either quality level (as reflected by the grand average) or inherent variability (as reflected by the average range), it was due to a change in the cause system producing the results. When no change was made in the cause system, there was no significant shift in grand average or range. No matter how long a process continues, significant shifts are very unlikely to occur unless there is a significant change in the raw materials or in the manufacturing process. If, after a manufacturing process has continued for some time, a significant shift in quality level or inherent variability has occurred, the cause of the shift will sometimes be apparent. If it is not, the manufacturer should search diligently for the cause until it is clear that further search would not likely be profitable.

7. *It is possible to go out of control limits and get back in without doing anything to the process.* Quality level shifts that are of small magnitude

or of short duration can readily occur without immediately revealing themselves. Shifts may be gradual or sudden, uniformly in one direction or erratic, or controlled or uncontrolled. Any combination of these conditions may occur with any degree of intensity. Shifts that are of slight magnitude, but long duration may result in only an occasional point falling out of control limits. Thus, if the manufacturer makes no deliberate change in the process during this time, it appears to him that the process has gone out of control and gotten back into control without any effort on his part. The truth of the matter is that the process has probably not been in control at the previous level or with the same magnitude of inherent variability as previously at any time during the period involved.

The greater the shift that occurs, the greater will be the likelihood of a point falling outside control limits, the more serious the situation will be, and the more frequently increased testing will be required in the armor program. However, any point that falls outside control limits should be regarded as a danger signal and every effort made (within economically practicable limits) to determine the reason for the indication of lack of control. Only very rarely do indications of lack of control occur without there being an assignable cause.

8. *My control limits have shifted and now a point is outside control limits whereas formerly it would have been within limits. Why is this point not considered a satisfactory condition?* Each plotted point on the control chart tells a most eloquent story in relation to its own control limits. Thus two points widely separated on the chart might have the same numerical value, but very different meanings. Suppose the first of these points falls within control limits. We can only assume from this fact that the product is continuing to be made in a controlled manner. Before the second point with which we are concerned occurs, many other points are accumulated which reveal that control has been achieved at a higher level. When the second point occurs it may now fall below the new lower control limit. It signifies that control is probably not being maintained at the new level. Any indication of lack of control must always be regarded as a danger signal regardless of when or where the indication occurs. In addition to our interest in the point's numerical value, we are also interested in its position relative to the control limits which apply to it.

9. *Why is going above the upper limit for averages undesirable when we are working to a specification minimum? Is this not a great deal better than can be expected?* If the point that goes above the upper limit is preceded by a gradual upward trend of the group averages in what appears to be a controlled manner, there is little likelihood of defective

material being produced. If, however, a point suddenly jumps out of the upper limit without any forewarning, it most likely represents a condition of lack of control. When the manufacturing process is out of control, almost anything can happen, including a sudden drop in quality. Frequently, such high points are followed almost immediately by ballistic failures. While a high level of quality is desirable, it is also very important that control be maintained. Without control we cannot expect to have a uniform product.

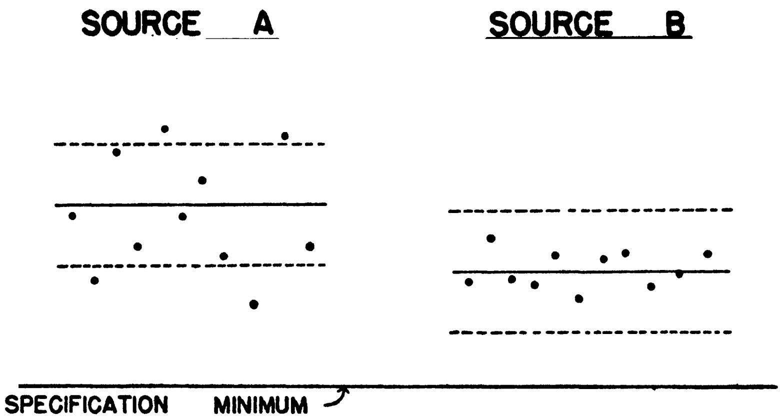
10. *If points for averages are permitted to go above their upper control limit to encourage shifts to higher levels, why are not points for ranges permitted to go above their upper limit?* The control chart in this application uses averages and ranges. The function of the averages is to reveal the level on which the process is operating. The function of the ranges is to reveal the amount of variability inherent in the process. The ranges do this independently of the process quality level and reveal nothing about its quantitative value. The average range, however, does enable us to establish the limits within which virtually all the group averages should fall. These limits are then placed above and below the process average quality level. Any given group average then indicates both a quality level and whether there is any indication of lack of control. Any given group range reveals both variability and whether there is any indication of lack of control. Thus, group averages that go above the upper control limit may possibly be the result of a gradually rising quality level, but a range that goes above its upper control limit can only indicate a lack of control.

11. *Is not an uncontrolled product at a higher level more desirable than a controlled product at a lower level?* While the average quality level of the process is important, the degree of control in effect at that level is also important, in fact vitally important. Without the existence of controlled operations, we can never be certain within what limits future observations will likely lie, within what limits untested material already made lies (the control chart is derived in this case from samples), or whether the existing level of average quality will be maintained.

In general, Source B would be definitely preferred to Source A, in spite of the fact that the average quality level shown for B is lower than for A. Since A shows several indications of being out of control, we cannot be sure that the average quality level shown is the true quality level for all material made during the period of time involved. Nor can we be sure as to the amount of untested material that would also fall outside the control limits, or what portion of it, if tested, would fall below the specification minimum, or what the future level or variability is apt to be. On the other hand, in the case of Source B, we have a high

degree of assurance that the quality average and variability of the untested material is essentially the same as that of the tested material, that extremely little, if any, of the untested material would fall below the specification minimum, and that the existing level and amount of variability probably will be maintained in the immediate future.

12. *What good is a control chart on a certain property if it is a different property in which we are interested?* This question has been raised by armor manufacturers who have had trouble with a different ballistic property (measured by an attribute testing method) than the one on which control charts are constructed. If the two properties are not re-



lated, such a chart will not be helpful. However, in the case of the armor program, it has been found that indications of lack of control tend very markedly to be associated with failures on other ballistic properties. Wherever the two properties are related, such a chart can be very useful.

13. *If the level of averages is high enough, is it not possible for a point to fall at least a little bit below the lower control limit without danger of ballistic failures?* A tabulation has been made for each point falling below the lower limit for averages according to the ratio of the number of standard deviations below the lower control limit as related to the number of standard deviations the lower control limit was above the specification minimum. Ratios as high as 138 were obtained. However, no level could be found at which freedom from the likelihood of some type of ballistic failure could be assured.

No failures for the property on which the control charts were constructed occurred above the ratio of 6.5, but other types of ballistic failures continued to occur at all levels.

14. *If one is interested in controlling a certain quality characteristic,*

should control charts be started immediately on all factors known or believed to affect the quality involved? Yes, if there are only a few factors involved, say two to four. No, if there are many. In the latter case it will be better to start with a control chart only for the quality characteristics it is desired to control. As indications of lack of control occur and causes are identified, control charts on causative factors may be added.

SUMMARY

1. Wherever the aim is to make many items all essentially alike, the quality control chart is applicable regardless of the number of variables in the manufacturing process.

2. It is also applicable regardless of the number of changes made in the manufacturing process from time to time.

3. It is also applicable regardless of whether the sample is adequately representative of any so-called "lot."

4. Any test method with sufficient precision to form the basis of acceptance or rejection of the material tested will be suitable for application of the quality control chart. In general, the amount of possible error in any individual test result should be small in comparison to the scale over which test results will normally vary.

5. The quality control chart is applicable to any process designed to make many items all essentially alike, regardless of whether any applications specifically comparable to the one in question have ever been made before.

6. Inherent variability in a type of product does not change significantly with the passing of time unless fundamental changes occur in the production process.

7. Any point that falls outside control chart limits indicates (with a high degree of probability) that a significant shift in quality level has occurred. Such indications may result from either a slight or large shift.

8. The significance of any point on a control chart (with respect to the degree of control it indicates), depends upon its position in relation to the control limits that apply to it.

9. A point falling above the upper control limit for averages must be regarded as a danger signal even if the only requirement is a specification minimum. It indicates an unstable process that may suddenly drop in quality level.

10. A point for ranges that falls above its upper limit reflects significantly increased variability in the product, a condition generally regarded as undesirable.

11. A controlled product at a somewhat lower quality level (provided minimum requirements are adequately met) is generally preferable to an uncontrolled product at a higher quality level.

12. A quality control chart based upon a certain quality characteristic can be helpful in gaining control of related properties.

13. No matter how high the average quality level may be, any point falling outside the control limits should be regarded as a danger signal.

14. In establishing a quality control program, control charts should first be constructed for the quality characteristic desired. Charts for causative factors may be added later as appears feasible.

INDUSTRIAL MATERIALS PRODUCTION, WORLD WARS I AND II*

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The reliability of a statistical comparison of production in the two wars is inversely related to its scope. It is not difficult, for example, to get reliable and comparable data on the production, in each war, of certain more or less standardized commodities, such as bituminous coal, pig iron, and wheat flour. And it is possible, I think, to draw rather interesting conclusions from such data, which, while limited in scope, conform to rather strict standards of reliability and comparability. Inquiries of broader scope, which aim to compare total production, or total commodity production, or total industrial production, are beset by two sorts of difficulties. One has to do with the discontinuities in the sphere of production, the other with the availability of data.

If the object is to compare the level of total output at analogous dates in the two wars (say 1917 and 1942), then some method must be devised for dealing with the fact that many of the goods produced in 1942 were not produced in 1917, and vice versa. Similarly, if the object is to compare the rate of change in total output during analogous intervals in the two wars (say 1914–17 and 1939–42), then some method of dealing with the fact that many of the goods produced in the later years of each war were not produced in the early years, and vice versa, is called for. One possibility is to define individual commodities so broadly that the discontinuities disappear. In order to get a continuous series one might, for example, have to define one commodity "motor vehicles," and to include under that term 1940 model automobiles of all makes, 1943 model tanks of all types, 1915 automobiles, and 1918 tanks. A simple count of these vehicles, or some more sophisticated system of counting or weighting, would produce a "continuous" series. In any case, in view of the widespread changes between and during the two wars in the kinds of goods produced, some method of equating new and old commodities is vital to comparisons of total output. Moreover, it is important to recognize that any method is bound to be

* Based on a paper presented before the Joint Regional Meeting of The American Statistical Association and The Institute of Mathematical Statistics, Washington, D. C., May 6, 1944. Considerable material has been drawn from *Production of Industrial Materials in World Wars I and II*, Occasional Paper 18, National Bureau of Economic Research, March 1944.

I wish to thank Johanna Stern and Karl Laubenstein for their able assistance in collecting data, and H. Irving Forman for his careful work in drawing the charts for this paper. I am deeply indebted to Arthur F. Burns for counsel at every stage of the inquiry.

unconventional, and hence require detailed specification if the results are to be understood.

These considerations would be even more important were it not for the fact that in many cases the data necessary to develop a given method do not exist. Some idea of the size of the gap in production statistics may be gathered from the fact that the direct coverage of Fabricant's index of manufactures, which is based on Census data, was only 55 per cent in 1914, 56 per cent in 1919, and 65 per cent in 1937.[1] Since there was no Census between 1914 and 1919, and none since 1939, the coverage of available annual data during the two wars is decidedly smaller than these figures suggest, although the wartime expansion of statistical inquiries undertaken for control purposes has tended to alleviate the situation. In any case, the gap to be filled if statistical comparisons of production in the two wars are to be comprehensive is large, and such attempts as have been made to fill it involve estimates of an exceedingly dubious character, as will be seen.

Truly comprehensive measures of production in wartime are, then, suspect on two counts. In the nature of the case they must employ definitions of commodities so broad, or methods of equating new and old commodities so arbitrary, as to be almost meaningless; and they must use estimates of production so flimsy as to be almost ridiculous. There is much to be said for the pursuit of a more modest aim—to learn what one can from data that are relatively homogeneous, continuous and reliable. The conclusions reached will not be global, but they will not be "globaloney" either.

Now the commodities for which homogeneous, continuous, and reliable data for the two wars are available are, for the most part, relatively unelaborated materials used in further production. Fabrication and differentiation are almost synonymous in practice. Such commodities as steel, copper, coal, cotton, and cement are basic materials in war as well as in peace, in this war as well as in the last. The statistics on the production or industrial consumption of these and similar commodities satisfy rather exacting requirements as to homogeneity and comparability, and in a sense, are comprehensive. For all fabricated products utilize materials of one kind or another, and for most of these materials statistics are available.

Because of their comprehensiveness in this sense, it seems worth while to compute an index from them, using value weights for products of domestic industry (minerals), and value added weights for products that originate outside domestic industry (in foreign countries or on

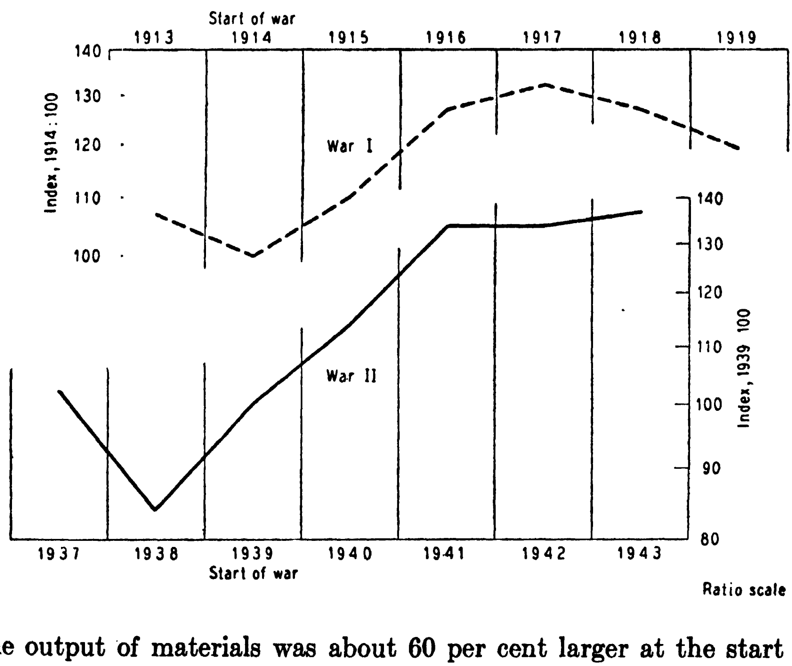
[1] Solomon Fabricant, *The Output of Manufacturing Industries, 1899–1937*, National Bureau of Economic Research, 1940, p. 602.

farms). Such an aggregate is not a well-defined total; its magnitude is determined primarily by practical considerations concerning the homogeneity of commodities and the availability of data. But for the purpose of wartime comparisons, and with all due qualification, it seems worth while to compute an index which represents a part of total industrial output that is both feasible to estimate and basic to the remainder, the more highly fabricated products.

In any case, such an index of industrial materials production has been constructed from data relating to 47 materials in both wars,[2] and is presented in Chart I. The salient features of the comparison are: (1)

CHART I

Industrial Materials Production, World Wars I and II



the output of materials was about 60 per cent larger at the start of World War II (1939) than at the start of World War I (1914);[3] (2) the production of materials expanded by similar percentages in both wars—around 30 to 40 per cent; (3) in both wars a rapid initial rise in production was followed by a period of relative stability—most of the increase

[2] Cf. Occasional Paper 18, *op. cit.*, p. 5. The World War II index presented here is based on revised data for the original list of series, and was computed with the assistance of Julius Shiskin of the Planning Division of the War Production Board, who adjusted the index to include confidential data. The revised index is (1937–43): 102, 84, 100, 114, 134, 134, 137.

[3] This is not indicated in the chart but is based on a recomputation of the 1914 index, using 1939 weights (*ibid.*, p. 5).

in materials output was achieved in the first two years of each war.

It is both a merit and a defect that this index is based on an identical list of materials in the two wars. The merit is that formal comparability is assured; the defect, that the result is biased. But the defect is tempered by the fact that the direction of the bias is clear: the use of an identical sample tends to reduce the rate of increase in the index in the second war relative to that in the first. This does not mean that the rate of growth shown by the index in World War II is actually too small; this would follow only if the rate of growth shown by the World War I index were either absolutely "correct" or too small. In other words, the actual rates of growth of the indexes during the two wars depend on the idiosyncrasies of the particular sample of commodities chosen; the fact that the sample is a constant one merely affects the relation between the rates of growth.

The magnitude of this effect, as well as the characteristics of the sample, have been discussed elsewhere.[4] Clearly, if the object had been merely to construct an index for World War II rather than to compare the two wars, the sample could have been improved. While it seems likely that such a revision would yield an index rising appreciably faster after 1941 than does the present one, this is not altogether certain.[5]

One reason for thinking that the comparison of the indexes in Chart I is not misleading is to be found in Chart II. The ten commodity series there depicted are a small but fairly representative sample of the type of series included in the index. It is evident that the similarity in behavior of the indexes in the two wars is, in considerable measure, the result of a general similarity in the behavior of individual commodities. The most prominent exceptions to this general similarity are lumber and cement, which advanced much more rapidly in the early years of War II than in War I, and aluminum, which advanced more rapidly in the later years of War II than in War I. But these exceptions do not mar the striking correspondence in average rates of change and in year-to-year behavior. In particular, the retardation shown by our index in the later years of both wars is seen to be rather widely diffused.

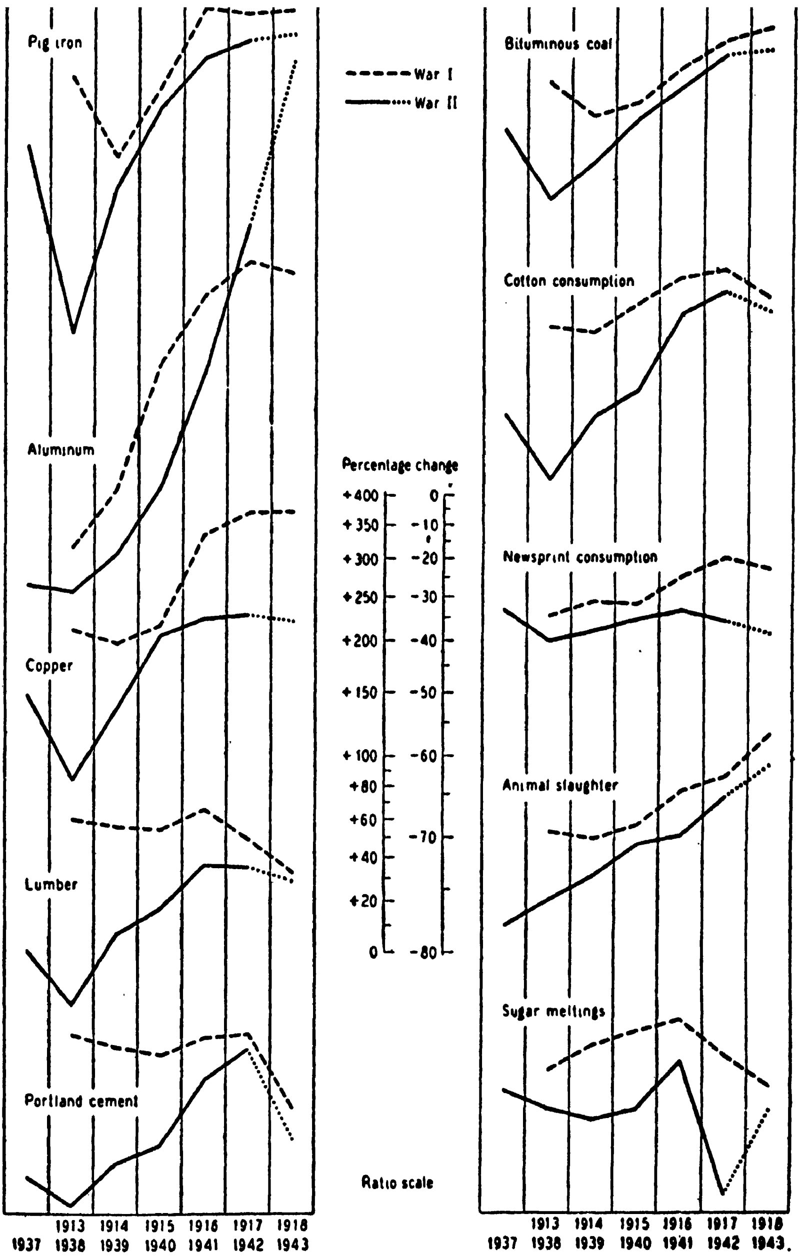
One other striking feature of the chart is the consistency of the changes from 1942 to 1943 with the general tendencies suggested by the movements in immediately prior years and in World War I. This chart was originally prepared by Arthur F. Burns and myself for use

[4] *Ibid.*, pp. 8–9, 32, 53–67.

[5] *Ibid.*, pp. 58–60. We have indeed taken a small step in the direction of revision, by adding rayon staple fiber to our index, substituting silk and nylon consumption for silk imports, and rubber consumption (crude, synthetic, and reclaimed) for crude rubber imports. The resulting index is (1937–43): 101, 83, 100, 112, 132, 136, 142. This revision does not have much to recommend it since it does not fully exploit the available data for World War II.

CHART II

Production of Basic Commodities, World Wars I and II



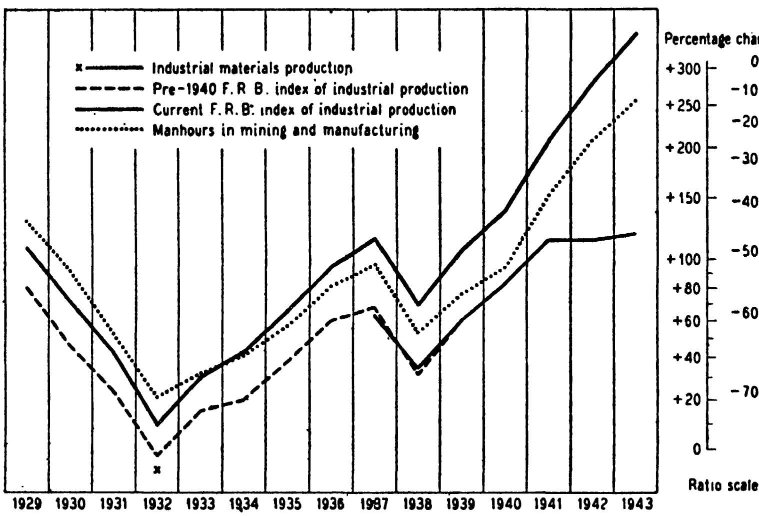
at a meeting in the fall of 1942, when only preliminary data for 1942 and no data for 1943 were available. In preparing it for publication now the 1942 data were revised and 1943 data added, as indicated by the dotted lines. While the 1943 figures were not, of course, actually forecast, it is gratifying to recall that considerable significance was attached to the similarity between the two periods and the then developing tendency towards a slackening rate of growth.

Do these comparisons of industrial materials production in the two wars suggest any conclusion with respect to total output in the two wars? The nature of the difficulty of measuring total output in wartime was indicated above. Some further evidence as to the difficulty is contained in Chart III. It will be observed that from 1929 to 1941 the

CHART III

Industrial Production and Employment

1929 - 1943



various production indexes move in rather close conformity with one another and with manhours in mining and manufacturing.[6] There is a difference in trend: the current Federal Reserve index rises relatively to

[6] Because of their similarity in coverage we have spliced the pre-1940 F.R.B. index (i.e. the index prior to its revision in August 1940) and the industrial materials index in 1939. The manhours index is based on B.L.S. estimates since 1939 ("Manhours in Agriculture, Mining, Manufacturing, and Construction, 1939–1943," mimeo. release LS 44–2729, Jan. 1944), and on a weighted average of Barger's index of manhours in mining and Fabricant's index of manhours in manufacturing prior to 1939 (H. Barger and S. H. Schurr, *The Mining Industries, 1899–1939: A Study of Output, Employment and Productivity*, National Bureau of Economic Research, 1944, p. 343; and S. Fabricant, *Employment in Manufacturing, 1899–1939*, National Bureau of Economic Research, 1942, p. 331).

the other production indexes, and the other production indexes rise relatively to manhours. But the difference in the trends of the production indexes, even when cumulated over the whole twelve-year period, 1929–41, is not nearly so large as the gap that develops in 1941–43 between the F.R.B. index and the materials production index; and the difference between the 1941–43 rates of increase in manhours and the materials index is almost as great, considering the prewar tendency for manhours to rise less rapidly than materials.

The following percentage changes relating to the war period summarize the situation:

	1939–41 Per cent	1941–43 Per cent
1. Current F.R.B. index of industrial production	49	47
2. Manhours in mining & manufacturing	43	41
3. Industrial materials production	34	2
4. Manhours per unit of materials, (2) ÷ (3)	7	37
5. Output per unit of materials, (1) ÷ (3)	11	44
6. Output per manhour, (1) ÷ (2)	4	4

It is clear that if the manhours and the materials indexes are valid there was a very considerable increase after 1941 in manhours per unit of materials. And if the Federal Reserve index is a valid index of total industrial production there was an equally remarkable increase in output per unit of materials after 1941, and a steady but moderate rise in output per manhour throughout the war period.

However, the computations underlying items 4, 5, and 6 above leave much to be desired in the way of comparability of coverage, statistical independence, and margin of error. The manhours index and the F.R.B. index are conceptually comparable, since both purport to cover mining and manufacturing. But neither is precisely comparable with the materials index, since the former does not include all the manhours used in fabricating materials, nor the latter all the output resulting from such fabrication. The principal omission is construction activity. If manhours in the construction industry were included in the manhours index the percentage change from 1939 to 1941 would be raised to 47 per cent, that from 1941 to 1943 lowered to about 32 per cent. The inclusion of the output of the construction industry in the F.R.B. index would presumably have similar effects.

It is clear that the manhours and the materials indexes are statistically independent computations. The F.R.B. and the materials index are not independent since most of the series in the materials index, or their close equivalents, are used in the F.R.B. index. This duplication

is, in part, inevitable, since materials output is necessarily a part of total output. But the duplication extends further, for by the system of "imputed weights" in the F.R.B. index many of the materials series are used to estimate the output of fabricated goods. The F.R.B. and the manhours indexes are not independent either, for the Board uses manhours figures to estimate production in a number of important industries.

I am not prepared to say what margin of error attaches to the manhours index. The possibilities of error in the materials index have been discussed elsewhere;[7] comparisons with other indexes covering similar areas of production, such as Ayres' grouping of F.R.B. materials series,[8] the materials index computed by the Board itself,[9] and the revision of our index described in note 5 above suggest that our index may understate the rise after 1941; but all these indexes show a much sharper decline in the rate of growth after 1941 than either the F.R.B. total index or manhours.

The error possibilities in the F.R.B. index have also been considered elsewhere.[10] It seems to me that the methods used to extend the coverage of the F.R.B. index, namely the use of imputed weights and the adjustment of manhours figures, are essentially arbitrary expedients and difficult to justify. An example of the use of imputed weights is afforded by the F.R.B. iron and steel index, which is based on three series: pig iron, with a weight (1935–39) of 1.70 per cent; open hearth steel, 8.70 per cent; and electric steel, 0.60 per cent. Part of the weight for open hearth steel (4.27 per cent) represents value added in the production of open hearth steel itself; the rest (4.43 per cent) represents value added in the rest of the "iron and steel industry," which concerns itself mainly with the fabrication of iron and steel products. In other words, the output of this part of the iron and steel industry is assumed to parallel the output of open hearth steel. To verify this assumption one would have to compute an index of output for this portion of the iron and steel industry and compare it with the open hearth steel series. Since there have been extensive changes in the kinds of products made by the industry during the war,[11] the validity of the assumption is not obvious, and it cannot be accepted even provisionally without specification as to how it has been, or could be tested.

[7] Occasional Paper 18, *op. cit.*, pp. 6–9, 53–67.

[8] Cf. *The Cleveland Trust Company Business Bulletin*, Feb. 15, 1944.

[9] This index, so far as I know, has not been published.

[10] Occasional Paper 18, *op. cit.*, pp. 40–52. See also Irving H. Siegel, "The Concept of Productive Activity," this JOURNAL, 39 (1944), pp. 227–228.

[11] Cf. Richard H. Lewis, "Conversion of Metalworking Industries to War Production, 1939–43," *Monthly Labor Review*, Dec. 1943, pp. 1086–87.

An example of the use of manhours series is afforded by the F.R.B. index of production for the automobile industry. The Board's method of computing this index, as the following figures indicate, is to multiply manhours by a productivity factor extrapolated on a straight-line

	Manhours	Productivity factor	Production
		April 1939:100	
April 1939	100	100	100
April 1940	120	101	121
April 1941	149	102	152
April 1942	131	103	135
April 1943	207	104	215

basis. Again, the necessity for justifying this procedure, and the difficulty of doing it, is clear, when the changes in the character of the output of this industry are recalled. In April 1939 about 400,000 persons were employed in the making of automobiles, trucks and parts. In April 1943 the automobile industry employed[12] about 653,000, but only 110,000 were engaged in plants whose major product was automobiles, trucks or parts; the other 543,000 were distributed as follows: aircraft and parts, 277,000; tanks and parts, 101,000; bombs, guns, ammunition and other ordnance, 92,000; armored cars and scout cars, 27,000; other products, 46,000.

Disregarding the possible divergence between the production of open hearth steel and consumption of steel by the part of the iron and steel industry that it is taken to represent, it seems that the method used implicitly by the Board is to "count" products of this industry according to the amount of steel contained in them as and when they are produced. The result of such a "count" would be the total amount of steel consumed in the industry. Obviously this is not the only way to count the diverse products of this industry, nor does it conform with the basic principle of the index, which is to "count" unlike products according to the value added in their production in 1937. Similarly, disregarding the productivity factor for the automobile industry, which has a rather slight effect anyway, the method apparently is to "count" automobiles, aircraft, tanks, etc. according to the manhours required for their construction as and when produced. This, again, is not the same as value added (or even manhours) in 1937. The importance of the use of imputed weights and of adjusted manhours series in the F.R.B. index prevents one from saying much about the specific margin of error in that index; it does not prevent one from indicating a lack of confidence in the index.

[12] *Ibid.*, pp. 1086–87, 1092.

These observations on the character of the indexes in Chart III lead me to conclude:

(1) that a sharp spurt in manhours of industrial employment relative to materials used in production did actually take place after 1941;

(2) that the evidence is not sufficient to warrant the finding that there was a similar rise in total industrial output per unit of materials, or that total industrial output per manhour increased steadily during the war.

INTERPRETING THE STATISTICS OF MEDICAL EXAMINATIONS OF SELECTEES

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The fundamental policies governing the registration and selection of men for military service are laid down in the Selective Training and Service Act of 1940, as amended. This act provides that every person "inducted into the land or naval forces under this Act for training and service shall be given a physical examination at the beginning of such training and service . . . ." While the initial selection of sufficient men to meet the needs of the armed forces is a responsibility of the Selective Service System, the final decision as to the acceptability of any selectee from the physical standpoint rests with the Army (or the Navy). The physical standards for induction into the Army have been determined by the War Department, upon recommendation of The Surgeon General. Hence, one of The Surgeon General's major functions has been to review the physical examination reports.

Until shortly after Pearl Harbor, Selective Service registrants not deferred on account of dependents, occupation or for other reasons were given complete physical examinations by local board physicians, in accordance with the physical standards set up by The Surgeon General. The results of such examinations were recorded on a Selective Service form and tabulations from samples of these forms were made by the Selective Service System. Selectees deemed acceptable for general military service by the local boards were sent on to Army induction stations for a final type examination, which alone finally determined whether or not they would be inducted. The findings of this induction station examination were entered on an Army form.

Following the outbreak of the war, inductions were stepped up and it soon became impracticable to continue the dual system of examinations described above. Local boards were accordingly instructed to examine registrants with the objective of eliminating those with manifestly disqualifying defects, such as would be revealed by an inspection in the nude, by serological tests or from information available locally. Selectees passing such preliminary screening were forwarded to induction stations for the decisive and more comprehensive examination. The findings of this examination were entered on the same form which also recorded the report of the physical examination at the local board. This form—Report of Physical Examination and Induction—thus be-

came the official document for recording the results of physical examinations of Selective Service registrants by both local boards and induction stations.

Early in 1944 the system of physical examinations of selectees was changed again. Local board examinations were limited to registrants claiming manifestly disqualifying defects, and serological tests at the local board level were discontinued. While the character of the examinations at induction stations was left unchanged, they were given to practically all selectees as "pre-induction" examinations to determine acceptability for service in advance of induction. Selectees later called to active duty have at time of actual induction (at an Army reception center or Navy recruiting station) been subjected to a final physical check-up for contagious diseases and any inter-current illness or injury. Under this system the Report of Physical Examination and Induction has continued to be the official document for recording the results of the physical examinations at the local board, if any, at the induction station and at the Army reception center or Navy recruiting station.

In addition, induction stations have maintained records of their daily examination activities as a matter of administrative control, as well as for the purpose of furnishing information to higher authorities. To meet these latter needs a standard form of daily worksheet and standard forms of periodical reports have been developed. The form of report to the Office of The Surgeon General covering the results of the physical examinations of selectees is, in effect, a monthly tally sheet for the individual reports of examinations processed at an induction station. This summary report rendered by every induction station has set forth the number of examinations, inductions and rejections, with the rejections classified according to the principal disqualifying defect categories and with details also given separately for special groups of men examined or inducted. Similar reports have been rendered since February 1944 by every Army reception center, covering the results of the physical check-up at time of actual induction.

To make possible the computation of rejection rates at induction stations, the number of men inducted by (or acceptable on pre-induction examination to) the Navy has also been reported to The Surgeon General.

Samples of the individual physical examination reports in punch card form provide the most practicable means for studying details of examination findings. However, the overall results of the examinations, especially for particular induction stations, can be gauged more readily from summaries of examination results at induction stations.

This paper is limited to the problems encountered in the interpreta-

tion of statistics compiled from (1) individual reports of physical examinations of selectees, and from (2) summaries of the examination results prepared at induction stations. The former deal with the results of the examinations at both the local boards and the induction stations while the latter are concerned solely with the examinations at induction stations. The following discussion will for the most part be confined to the medical examinations of selectees at induction stations.

THE SELECTEES EXAMINED AT INDUCTION STATIONS

The individuals examined at an induction station must be regarded as a specially selected and highly variable sample of the male population at a particular time and place. The varying proportion of agricultural and war workers in the local population has had an important bearing on the type of man available for service. The composition of the group of selectees actually sent up for examination has been affected by prevailing Selective Service policies in regard to deferments for dependency, by the Armed Forces' policies in regard to the acceptance of special groups, by differential screening at the local boards, and by the extent to which men previously rejected were sent up again for examination. As a result, marked variations have been observed in the rejection rates at different induction stations at a particular time and at the same induction station at various times.

Changes in the type of selectee forwarded to induction stations can be associated in point of time with directives ordering review and reclassification of registrants previously deemed unavailable or unacceptable for military service. Thus the procedures laid down by Selective Service in July and August of 1943 for reclassifying registrants had the effect of increasing the proportion of previously rejected men sent up to induction stations in subsequent months. On the other hand, the calling up of fathers in significant numbers during the last quarter of 1943 is believed to have slowed down the rejection rate at induction stations, at least to the extent that fathers took the place of previously rejected men who might otherwise have been sent up for reexamination in greater numbers.

The effect of changes in the policies of the Armed Forces was especially notable in respect to volunteers, special groups and selectees with certain remediable defects. From December 1941 to November 1942, when the minimum age for service under the Selective Training and Service Act was twenty, the acceptance by the Armed Forces of volunteers at ages under twenty markedly affected the type of selectee age twenty sent up for induction. Since December 1942 a similar situation has existed for selectees aged eighteen, because of age seventeen

enlistments into the Navy, the Enlisted Reserve Corps and the Air Corps Enlisted Reserve. More spectacular in their effect on the overall picture of physical examination findings at induction stations were the limitations on the acceptance of illiterates, limited service men and other special groups. When such limitations were removed, there was a tendency toward "unloading" by local boards of the men who had previously been unacceptable. Likewise the decisions to accept men with certain remediable defects (such as tooth defects, visual defects and venereal diseases) temporarily increased the proportion of selectees with such conditions. This is illustrated by the situation which developed during the latter part of 1943 in regard to men with venereal diseases. Because of the special efforts made at that time to induct men once unacceptable on account of venereal infections, the proportion of Army inductees with venereal diseases during the last three months of the year was about double that for the year as a whole.

The nature of the screening at the local boards was first changed from a complete examination to an inspection type of examination during the first quarter of 1942. It was again changed early in 1944 by limiting local board examinations to men claiming disqualifying defects.

While the screening at local boards is relatively limited in scope, differences in this screening have nevertheless been an important factor affecting the interpretation of physical examination findings at induction stations. This was brought out in a study[1] of 4,994 men disqualified for general military service on account of cardiovascular defects, in which it was found that the proportion of men rejected for cardiovascular conditions at local boards was materially higher in New York, as compared with Boston. Differences in the screening effect of local examinations seem to reflect largely the differences in local board attitudes towards deferment, towards persons with borderline defects and towards sending back for reexamination men previously rejected at induction stations.

The most telling influence recently exercised by local boards on the type of man sent up to induction stations has proceeded from the reclassification and sending up for reexamination of men previously rejected. Except when changes in standards are involved, rejected men are again sent up for examination and induction only after the case has been reviewed by the local board's medical advisory board. The reconsidering of previously rejected men has naturally tended to be more intensive at those local boards which were hard pressed to meet their quotas. It appears that such reconsideration may have been more

[1] "Report of Reexamination of 4,994 Men Disqualified for General Military Service," *Journal of the American Medical Association*, Vol. 123, pp. 937–944 and 1029–35.

frequent for the milder psychiatric disorders than for other disqualifying defects.

The net result of these and other influences has been to confront induction stations with men whose characteristics have varied more widely than would generally be supposed.

THE NATURE OF THE INDUCTION STATION EXAMINATION

The findings of the examinations at induction stations are influenced by the objective of these examinations, by the examining procedures and by factors such as idiosyncrasies of the examining personnel and the attitude of the examinees.

The objective of the induction station examinations is to select men who are fit for the rigors of military service. However, Army regulations further provide that care should be taken not to accept men whom it may be necessary to discharge within a short time, and that the likelihood of subsequent claims on the government should be kept in mind by the examiners in considering the qualifications of registrants with questionable defects.

The standards of fitness for military service have been developed over a period of time as a matter of medical judgment and impressions gained in World War I. Such standards are of necessity subject to change since they have to be readjusted in relation to the Armed Forces' needs for men and the available supply of manpower. This is clearly demonstrated by the successive modifications made in U. S. Army peacetime standards with the progress of the war. The different standards used in Great Britain and the reported relaxation of standards in Germany also illustrate the fact that standards for military service can vary considerably under different circumstances. Quantitative experience data are unfortunately lacking regarding the relationship between findings upon examination and subsequent record of fitness, such as could serve as a check on the reasonableness of different standards.

It is important to keep in mind that the present Army standards take into consideration not only the really serious health impairments but also structural physical defects and mental conditions which can interfere with the performance of Army duties or otherwise render a man unfit for Army service. Such defects would not necessarily impair a man's health or prevent him from pursuing his civilian occupation. To a limited extent it has proved possible to utilize in the Army men who because of slight defects could not qualify for general military duties, but who could nevertheless be of value on special less physically exacting assignments.

Although Army regulations provide for the rejection of men who appear likely to become disabled in the near future, current fitness for general military service remains the fundamental criterion of the examinations. Consequently, the emphasis in the examinations has been on the detection of obvious defects which bear directly on acceptability for general military service. In respect of such defects the examinations have proved to be quite adequate.

In the case of borderline or doubtful findings, the Army regulations emphasize that the standards are simply a guide to the discretion of the examiners and that such standards should be construed, neither too strictly or arbitrarily, in the light of the objective of securing men who are physically fit. Since the great majority of defects are not measurable, considerable latitude must be allowed in the interpretation of borderline findings. This has operated to produce varying interpretations of standards in different localities. Recourse to the advice of consultants has sometimes also had the same effect, notably for defects in whose case precise diagnoses are difficult to make, for example certain psychiatric and cardiovascular defects. It should be borne in mind in this connection that most of the examiners at induction stations are civilian physicians, many of them specialists, imbued with an individualistic approach and not accustomed to following rules implicitly.

In respect of minor defects or conditions which do not bear directly on a selectee's acceptance for service, the examinations have not been very searching. The dominant factor in this regard has been the time element. Maximum attention has properly been focused, within the time available for the examination, on the detection of the principal causes of rejection. Since the examinations have not been made with the view of detecting all the minor defects, irrespective of their relevance to a man's acceptability for military service, they do not furnish a really satisfactory basis for determining the incidence of minor defects. In this respect, however, the examinations under pre-war physical standards will be found to provide much better information regarding minor defects than the examinations made since March 1942, when large scale inductions under standards adapted to war-time manpower needs began. Dental caries furnishes a good illustration. Following the lowering of the standards for teeth in February 1942, carious teeth ceased to be an important consideration in dental examinations and such examinations have since been frequently made with a tongue depresser only. As a result the reported incidence of dental caries among selectees has been of little value as an index of the actual condition.

Another limitation of the induction station examinations proceeds

from the examiners' reliance on the selectees for certain pertinent information. This has been especially important in getting medical histories, which provide the essential clues to the interpretation of many psychiatric, cardiovascular, and gastro-intestinal symptoms. Selectees anxious to be accepted into the armed forces have undoubtedly withheld unfavorable information, while those wishing to escape service have not infrequently exaggerated existing defects or simulated imaginary ones. The Armed Forces' experience with malingerers has not been one to constitute a serious problem, but the records of volunteers discharged for medical reasons have sometimes suggested the suppression of vital facts regarding medical histories.

The foregoing remarks are intended to stress the limitations on the use of physical examination findings of selectees for the purpose of appraising general health status or the incidence of minor defects. They also call attention to the bias sometimes introduced into the data by idiosyncrasies of the examining personnel and by the attitude of the examinees.

THE RECORDING AND REPORTING OF THE EXAMINATION RESULTS

The most serious difficulties originally encountered in the interpretation of the results of physical examinations can be traced to a lack of adequate instructions for recording and summarizing the examination findings. Successive improvements in instructions designed to effect uniform and consistent reporting and periodical checks on the observance of such instructions have generally proved sufficient to eliminate the worst disparities in reporting.

In tabulating the individual records of examination, the major problems were those of wide variations in terminology, indefinite terminology and differences in the interpretation of standards. These difficulties were in large part solved by the preparation of a special code for defects considered of importance for military service. This code was based on the conditions actually reported on individual reports of physical examinations, and was clearly preferable to adaptations of mortality or morbidity codes, since it related to the actual conditions affecting fitness for military service.

A more difficult problem was that of defining the defect responsible for the rejection in cases involving multiple disqualifying defects. For some time it was the practice to give psychiatric defects priority over physical defects, chiefly because of the great interest in psychiatric disorders. Recently a rule was promulgated that the most permanent and irremediable defect be listed as the principal defect responsible for rejection. No suggestions, however, were offered as to which defects

should be preferred in common combinations of disqualifying defects, many of which are related to one another.

Giving priority to psychiatric defects over physical defects had the effect of understanding the incidence of disqualifying physical defects among selectees. With this priority in effect, the higher the rejection rate for psychiatric defects the more did the reported rejection rate for physical defects understate the actual incidence of disqualifying physical defects. This was an important consideration in comparisons of rejection rates for physical defects between white and colored selectees, since the latter have been subject to much higher rejection rates for mental or educational deficiency.

In the case of summarized data reported monthly by induction stations to The Surgeon General, the most troublesome question has been that of allocating defects to the categories required to be reported. In the absence of specific directives there were considerable differences in practice from one induction station to another. Thus epilepsy was classified sometimes as mental and sometimes as neurological; poliomyelitis residuals were sometimes grouped with neurological defects and sometimes with musculo-skeletal. This unsatisfactory situation was eventually remedied by issuing a guide which lists a large number of defects, in regard to the allocation of which there might be some difference of opinion.

Differences in reporting practices are believed to be among the chief reasons responsible for the wide variation in rejection rates for individual defects from one area to another and especially from one induction station to another. Because of this, as well as the differences in the interpretation of standards and differences in local board screening, it has been very difficult to judge the extent of the geographical differences in the incidence of disqualifying defects.

INTERPRETATION OF THE RESULTS OF THE EXAMINATIONS OF THE SELECTEES

The results of the examinations of selectees have as a rule been presented in the form of rejection rates analyzed according to the principal defect categories responsible for rejections, and by race, by age, and by induction station (or broader areas, such as Service Commands). The typical problem has been to account for the changes in rejection rates by reference to changes in induction policies, procedures and standards, and by reference to the known locally specific differences in the characteristics of the men sent up for induction. This has involved constant attention to the changes being made in Selective Service and Armed Forces' policies, procedures and standards, insofar as they af-

fected the type of man sent up for induction, the type of man accepted and the examinations themselves.

Many of the changes in the trends of rejection rates could not be satisfactorily explained. Frequently the explanations lay in the technical features of the examination rules or the reporting. This has called for studied awareness of the peculiarities of the examinations and of the reports concerning them. In numerous instances, interpretation of the data has required primarily a statement of their limitations. This has been especially the case where there was some likelihood of the data being used for purposes for which they were not intended or for comparison with other series.

Thus, it has appeared advisable to stress that rejection rates had been computed on the basis of the number of examinations and not the number of individuals. To the extent that many selectees had been examined and rejected more than once, the rejection rates based on examinations have of course overstated the rejection rates which would have been obtained from an unduplicated count of the individuals examined. In other words, rejection rates computed on the basis of examinations have exaggerated the incidence of disqualifying defects, especially for those defects for which previously rejected men were prone to be sent up for reexamination.

Likewise, it has seemed wise to point out repeatedly that the high rejection rates reported during the prewar period of Selective Service did not imply a low level of national health. The then effective standards for military service were in many respects different from the standards of health compatible with efficient performance in civilian life, so that men failing to meet them could not necessarily be regarded as sick or disabled.

The question has often been raised as to what the findings of the medical examinations would have been, if a particular group of selectees had been more representative of some larger population. In those cases where it was possible to appraise the more important selective influences in quantitative terms, their effect could readily be allowed for. Not infrequently, however, the effect of such influences could at best only be estimated from general knowledge of the situation as falling within a wide range. This proved to be no less true in the case of relatively large groups of selectees, such as those examined in broad sections of the country over a long period of time, than when dealing with selectees examined at a particular induction station during a single month.

Misunderstanding has sometimes been occasioned by comparisons of rejection rates with other only partially parallel series. To avoid

such misunderstandings, the major points of difference have been stressed even in comparisons with reasonably similar series. Thus in comparing medical rejection rates for WAAC candidates with corresponding rates for selectees, the fact that the applicants for enrollment in the WAAC were volunteers was carefully emphasized. As volunteers the WAAC candidates were subjected to considerable screening before being medically examined, whereas the selectees examined at induction stations had not been subjected to any comparable screening and furthermore included a sizeable proportion of previously rejected men.

Questions have also arisen in regard to the relationship between rejection rates and discharge rates for individual induction stations or wider areas. Such comparisons were first made because of the feeling that the adequacy of the examinations at induction stations could be judged by the proportion of inductees discharged within a short time after induction. This tentative conclusion was based on the theory that induction stations with high rejection rates were selecting men for the Army so efficiently that the subsequent discharge rates would be small. Conversely, induction stations which showed low rates of rejection would be expected to have higher rates of discharge. This reasoning assumed that induction station examinations were pointed at and could be highly effective in eliminating potential discharges and that differences in the type of man sent up for induction between one induction station (or area) and another could be disregarded, so that the rejection rates could be expected to reflect chiefly the differences in the screening at various induction stations.

It is not surprising that lack of correlation between rejection rates and discharge rates was therefore sometimes misconstrued as being indicative of inadequate examinations at some induction stations. Actually, a number of combinations of circumstances could have accounted for lack of correlation.

For instance, if the ability of all induction stations to detect potential discharges traceable to a man's condition at time of induction was of a uniformly low order, correlation between rejection rates and discharge rates could not be expected. Since it now appears that induction station examinations are not markedly selective of potential discharges for at least certain types of defects (e.g. certain psychiatric disorders) lack of correlation between rejection rates and discharge rates for such defects is not surprising. In this connection it should be recalled that induction station examinations were designed to determine current fitness rather than to detect potential discharges. No definitive studies moreover have been made of the effect of particular defects on the discharge rate, analogous to those carried out by life insurance companies to

determine the effect of particular medical impairments on mortality.

If the ability to detect potential discharges traceable to a man's condition at time of induction varied markedly from one induction station to another, some inverse correlation between rejection rates and discharges might, a priori, be expected. However, available evidence suggests that this could be completely masked by the differences between induction stations in respect of the type of selectee sent up for induction.

Finally it is necessary to keep in mind that the induction station examination cannot influence the discharges which result from the fortuitous incidents of military service nor from other conditions which develop after induction. If the ratio of discharges traceable to the physical state of selectees at time of induction to total discharges were relatively small, such correlation as existed between rejections and discharges due to the physical state of selectees at time of induction might, nevertheless, not be perceptible in comparisons between rejection rates and total rates of discharge.

Thus, only in the case of induction stations with reasonably similar types of selectees, but with varying ability to detect potential discharges could any inverse correlation be expected between rejection rates and discharge rates, and this correlation would be perceptible only if discharges originating from conditions existing at time of induction constituted a sizeable proportion of all discharges.

APPLICATIONS OF THE STATISTICS OF MEDICAL EXAMINATIONS OF SELECTEES

The statistics of medical examinations of selectees have proven of great value to the Army for administrative purposes and in furnishing information regarding the physical characteristics of the men inducted and rejected.

The individual reports of physical examinations have made it possible to determine rejection rates for particular physical and mental defects in considerable detail. They have also been the only source of information regarding rejections by age, a matter of great importance in shaping policies for the most effective use of manpower. Knowledge of rejection rates for individual defects, by age, race and for broad subdivisions of the country has been extremely pertinent in revisions of physical standards. In this connection, estimates were frequently made of the number of men rejected for certain defects, who would become available to the armed forces if standards for the particular defects, were modified. This has involved translating the rejection rates based on the number of examinations into rates reflecting the numbers

of individuals rejected and also studies of the association between disqualifying defects, in order to make allowance for the number of men with a particular disqualifying defect who also had other disqualifying defects.

The summary reports of medical examinations at induction stations have furnished the absolute numbers of examinations and rejections (by cause) for each induction station. This information while somewhat limited in scope has greatly facilitated comparative reviews of examination results at different induction stations. The summary reports have also served as controls on the examination practices of induction stations. As such they were instrumental in obtaining more uniform adherence to standards and in the improvement of procedures. The reports have also supplied current data regarding special groups, for instance limited service men, illiterates and inductees with venereal diseases.

Certain details of the physical characteristics of Army inductees, notably their height and weight distributions, have been very much in demand, and were readily obtained from sample tabulations of the individual physical examination reports. Dental findings, especially for non-restorable teeth, have been used to estimate the dental work required to be done for inductees. Findings on visual acuity have also been used for similar purposes. Most of the requests for information regarding physical characteristics of the Army have related to specific practical problems and little has been done so far to obtain a general physical picture of the men in the Army.

The desirability of developing quantitative judgments regarding the prognostic significance of physical characteristics suggests that follow up studies be made for samples of inductees with certain characteristics at time of induction. Such investigations could trace the amount of time lost from duty on account of sickness or disability and the number of discharges for each group, relating the days lost or the discharges to the average experience of the Army. In this manner numerical measures could be obtained of the extent to which the experience of inductees with certain physical characteristics departed from the average for the Army as a whole. Such indices should prove helpful not only in the consideration of standards of fitness for service, but also in shedding light on the effect of physical and mental defects on morbidity and the occurrence of disabilities.

APPLICATION OF THE LOGISTIC FUNCTION TO BIO-ASSAY

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Following the observation that under certain circumstances, if the dosage of a drug is expressed in proportion to its logarithm, the effect, measured as the percentage of individuals killed (or other all-or-none effect) in relation to the dosage, assumes the form of a more or less symmetric sigmoidal curve, the integral of the normal curve has been employed for the estimation of the potency of a drug [5]. Bliss has applied and advanced this method extensively.

I have utilized for the same purpose another function given by equation (1) and shown in Chart I, owing to my familiarity with its application to other experimental problems [12]. The laboratory of Professor E. B. Wilson also has used this function for this purpose [14]. The function (1) has been variously called the "growth function," the "autocatalytic curve" and by other terms, according to the application to which it was put. It was rediscovered for the description of population growth by Pearl and Reed [11] who, following Verhulst, called it the "logistic" function. Since its wide statistical use stems, I feel confident, from the extensive applications made by Pearl and Reed, I shall refer to it by the general term "logistic."

The use of the integral of the normal curve to give the proportion of individuals affected at a given dosage follows nicely from the hypothesis that the susceptibility among individuals is distributed according to the normal curve. If the minimal lethal dose measures susceptibility and if susceptibility is distributed normally among individuals, it follows that the proportion of individuals in a population exposed to a dosage x which will be killed will be the integral up to x of the normal curve of distribution of susceptibility. In view of the wide use of the normal curve to represent the distribution of biologic traits and also because of direct experimental evidence of the normal distribution of susceptibility [4], it is to be conceded that the integral of the normal curve recommends itself.

However, the logistic function is very close to the integrated normal curve [17], it applies to a wide range of physicochemical phenomena [12] and therefore may have a better theoretic basis than the integrated normal curve. Moreover there are reasons for believing it to be easier

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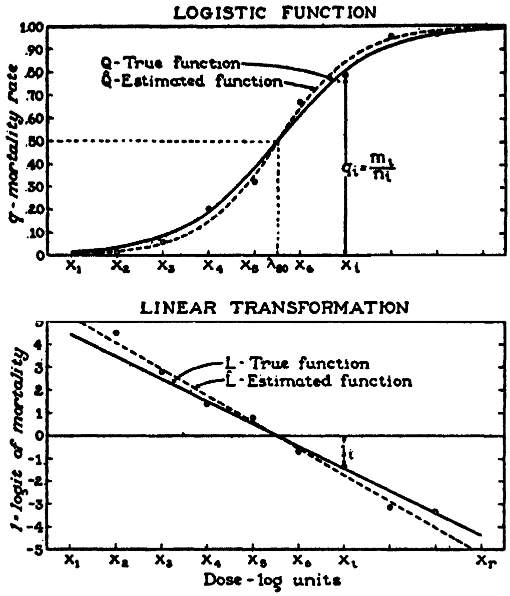
CHART I

THE LOGISTIC FUNCTION AND ITS LINEAR TRANSFORMATION



The following are definitions of the quantities shown in Chart I or used elsewhere in the paper and equations used in the paper:

Q = "True" logistic function of mortality rate versus x corresponding to parameters α and β

$P = 1 - Q$

$\widehat{Q}$ = fitted function corresponding to a and b, estimates of the parameters

$\widehat{P} = 1 - \widehat{Q}$

x_i = dose in log. units

q_i = observed mortality rate for dose $x_i = \dfrac{m_i}{n_i}$

$p_i = 1 - q_i$

m_i = number of dead at x_i

n_i = number exposed at x_i

$\lambda 50$ = log L.D. 50, the dose for which the mortality rate is 50 per cent $= \alpha/\beta$

$l = \text{logit} = \ln \dfrac{(1-q_i)}{q_i} = \ln \dfrac{p_i}{q_i}$

L = logistic function in terms of logits corresponding to Q

$\widehat{L}$ = logistic function in terms of logits corresponding to $\widehat{Q}$

$$Q = \frac{1}{1+e^{\alpha-\beta x}} \tag{1}$$

$$\widehat{Q} = \frac{1}{1+e^{a-bx}} \tag{2}$$

$$\ln\left(\frac{1-\widehat{Q}}{\widehat{Q}}\right) = \widehat{L} = a - bx \tag{2.1}$$

$$\frac{\partial \widehat{Q}}{\partial a} = -(\widehat{Q})\,(1-\widehat{Q}) = -\widehat{Q}\widehat{P} \tag{3}$$

$$\frac{\partial \widehat{Q}}{\partial b} = x(\widehat{Q})\,(1-\widehat{Q}) = x\widehat{Q}\widehat{P} \tag{4}$$

to handle statistically. I, therefore, thought it would be worth while to examine both forms comparatively.

For the purpose, there were collected as many examples as I could find of dosage mortality data in which the observations were sufficiently numerous and for which the integrated normal curve had been used already. The logistic function was applied to the same data and the results were compared. For the normal curve, evaluations by the method of maximum likelihood formulated by Bliss and Fisher [1] were utilized as given by the authors of the examples used when they were available, and when they were not, by obtaining a solution following the same method.

For the application of the logistic function, the question arose as to what method of fitting to utilize, and in particular whether to attempt to fit by the method of maximum likelihood. The principle of this method has been employed by many workers in particular situations, but under the name of maximum likelihood it has been advocated for general application by Professor R. A. Fisher. The method seems to be favored also by other mathematical authorities including, at least for the present application, Professor E. B. Wilson [12].

In spite of earnest prayer and the greatest desire to adhere to proper statistical behavior, I have not been able to see why the method of maximum likelihood is to be preferred over other methods, particularly the method of least squares. In the logistic function (1) there are two parameters α and β which if known determine the effect at any dose. The L. D. 50, that is, the dose which is lethal to just 50 per cent of the population exposed, is given by α/β. The principle of maximum likelihood is to choose such values a and b as estimates of α and β as would, if they were actually the parameters α and β, give the observations in hand with greater probability than any other values. That is, if values a_1, b_1, for α, β give the observations in hand with greater probability than values a_2, b_2, the values a_1 b_1 are said to have greater likelihood than a_2, b_2, and the values which give the observations with greatest probability are those of maximum likelihood. The maximum likelihood values are determined by obtaining the expression for the probability of all the observations occurring together, or its logarithm, differentiating with respect to the parameters and solving for maximum values. The method has considerable immediate plausibility. It employs a principle used in inverse probability and it has a generality which is attractive. However, the results that it gives in some cases conflict with other principles that seem equally well or better established. It is known that in some instances the method yields biased estimates of the parameters, that is, the expected value of the estimate does not equal, but is greater or less than the true value. If the method of maximum

likelihood and that of least squares give different results in the case of fitting a curve, it is an open question whether the χ^2 distribution applies to deviations from the maximum likelihood solution or from that given by least squares, and I suspect strongly that the standard errors of the estimated parameters will be larger for the method of maximum likelihood.

If the mortality rate at x_i is $Q_i(P_i=1-Q_i)$ the probability of an observation $q_i=m_i/n_i$, that is, m_i deaths out of n_i exposed, is given by

$$P\{q_i \mid x_i\} = \frac{n_i!}{n_i!(n_i - m_i)!} Q_i^{m_i} P_i^{n_i - m_i} = C_i Q_i^{m_i} P_i^{(n_i - m_i)}. \tag{5}$$

The probability of all the q's taken together is given by the product of (5) for all the q's. L, its natural logarithm[1] with Q taken from the estimated logistic function (2), is the sum of the logarithms and is given by

$$L = \sum \ln C_i + \sum m_i \ln \widehat{Q}_i + \sum (n_i - m_i) \ln \widehat{P}_i. \tag{6}$$

The derivatives of L with respect to a and b, which are to be equated to zero for maximum likelihood with appropriate substitutions from (3) and (4), are

$$\begin{aligned} \frac{\partial L}{\partial a} &= \sum \frac{\partial \widehat{Q}}{\partial a}\left(\frac{m_i - n_i\widehat{Q}_i}{\widehat{Q}_i\widehat{P}_i}\right) = -\sum (m_i - n_i\widehat{Q}_i) \\ &= -\sum n_i(q_i - \widehat{Q}_i) = 0 \end{aligned} \tag{7}$$

$$\begin{aligned} \frac{\partial L}{\partial b} &= \sum \frac{\partial \widehat{Q}}{\partial b}\left(\frac{m_i - n_i\widehat{Q}_i}{\widehat{Q}_i\widehat{P}_i}\right) = \sum x_i(m_i - n_i\widehat{Q}_i) \\ &= \sum (n_i)(x_i)(q_i - \widehat{Q}_i) = 0. \end{aligned} \tag{8}$$

From (7) and (8) the conditions for maximum likelihood are

$$\sum n_i\widehat{Q}_i = \sum n_i q_i \tag{9}$$

$$\sum n_i x_i \widehat{Q}_i = \sum n_i x_i q_i. \tag{10}$$

According to the principle of least squares the sum of the weighted squared differences $\sum W_i(q_i - \widehat{Q}_i)^2$ is to be minimized, with the weight W_i taken as inversely proportional to the variance of the observation q_i. The variance of q_i is P_iQ_i/n_i. For this condition of least squares a solution cannot be given directly in terms of the logistic in form (1), for the primary reason that the function in this form is not linear in the parameters to be evaluated, and also because the weights con-

[1] L used in (6), (7) and (8) has a different connotation than when used elsewhere in this article.

tain the unknown quantities PQ. It can be expanded in terms of a Taylor series and a least squares solution obtained as closely as desired by successive approximation. This method is classic and numerical examples are given by Schultz [13] and by Pearl [10]. It is a rather arduous procedure, however. If instead of the observations q_i we deal with their logits[3] $l_i = ln(p_i/q_i)$ then for not too large differences, $(q_i - \widehat{Q}_i)^2$ is given with close approximation by

$$(q_i - \widehat{Q}_i)^2 \rightleftarrows (\widehat{P}_i\widehat{Q}_i)^2(l_i - \widehat{L}_i)^2 \tag{11}$$

or better still by

$$(q_i - \widehat{Q}_i)^2 \rightleftarrows (\widehat{P}_i\widehat{Q}_i)(p_iq_i)(l_i - \widehat{L}_i)^2. \tag{11.1}$$

If now, since we do not know the "true" values PQ we define the least square weights in terms of the fitted function we have from (11.1)

$$\chi^2 = \sum \frac{n_i}{\widehat{P}_i\widehat{Q}_i}(q_i - \widehat{Q}_i)^2 \rightleftarrows \sum n_i(p_iq_i)(l_i - \widehat{L}_i)^2. \tag{12}$$

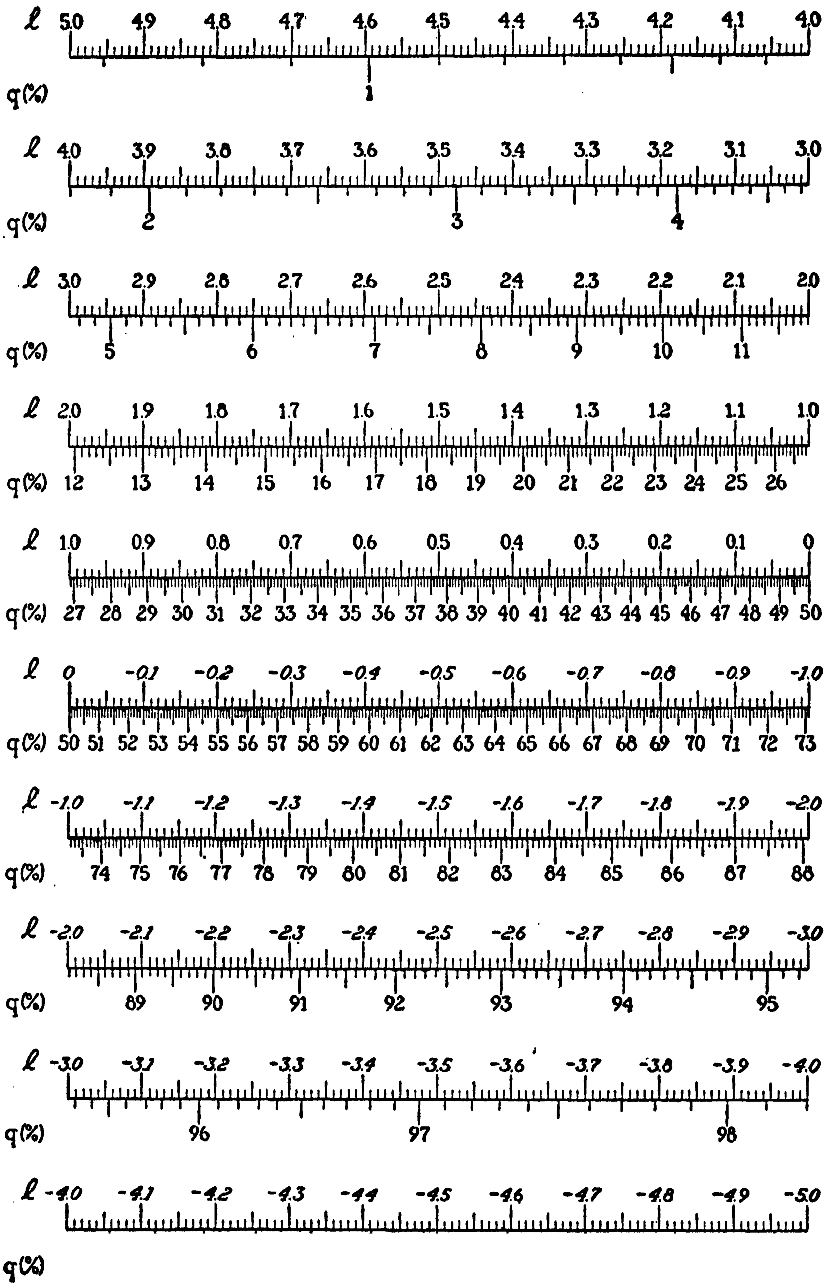
It is the quantity on the left of (12) which according to the principle of least squares is to be minimized. The fact is notable that by use of the approximation (11.1) which is a good one, the weights on the right side of (12) are formulated entirely in terms of the observed quantities n and pq, that is the weights do not contain the fitted values $\widehat{P}\widehat{Q}$. This simplification is exceptional with the logistic for fitting a function to a series of observed rates by least squares; for instance, this sort of reduction does not result from a similar treatment of the exponential or the integrated normal curve. A consequence of (12) is that a least square solution can be obtained directly without successive approximation in spite of the fact that the function (1) is not linear in the parameters, the degree of exactness being limited only by the approximation (11.1). Since $\widehat{L} = a + bx$ the problem is reduced to that of obtaining a least square solution of a linear function with weight $W_i = n_ip_iq_i$ for l_i instead of the more usual n_i. The method of solution then is as follows.

For each observation q_i at x_i the logit $l_i = ln(1 - q_i/q_i)$ is evaluated. Chart II gives the logits corresponding to different values of q conveniently and with sufficient accuracy for most purposes. A least square solution for the function in linear form for logits (2.1) is obtained weighting each observation with the weight $W_i = n_ip_iq_i$. This will be a close approximation of a least square solution in terms of the

[3] I use this term for ln p/q following Bliss, who called the analogous function which is linear on x for the normal curve "probit."

CHART II

NOMOGRAPH FOR OBTAINING THE LOGIT (l) CORRESPONDING TO A GIVEN MORTALITY RATE (q) AND VICE VERSA



logistic (2). An example of the arithmetic procedure is given in Table I. In some instances the observed mortality was zero or 100 per cent. For such an observation the logit cannot be utilized since it becomes infinite at these values. In that case a preliminary solution can be obtained omitting the observation in question and a substitute observation used, half way between the estimate given by this fit and the actual observation.[3]

TABLE I
CALCULATION OF LOGISTIC FUNCTION

Concentration	Number exposed n	Mortality rate q	Log concentration x	Logit l	Weight $= npq$ w	wx	Expected logit $\hat{L}$	Expected mortality $\hat{Q}$	$\widehat{PQ}$	$\text{Chi}^2 = \frac{n(q-\hat{Q})^2}{\widehat{PQ}}$ χ^2
40	462	.2359	1.6021	1.175	83.28	133.4229	1.262	.2206	.171936	0.629
60	500	.3980	1.7782	0.414	119.80	213.0284	0.266	.4339	.245631	2.623
80	467	.6380	1.9031	−0.549	108.39	206.2770	−0.441	.6085	.238228	1.255
100	515	.7184	2.0000	−0.937	104.19	208.3800	−0.990	.7291	.197513	0.299
120	561	.8182	2.0792	−1.504	83.45	173.5092	−1.438	.8081	.155074	0.369
140	469	.8529	2.1461	−1.758	58.84	126.2765	−1.816	.8601	.120328	0.202
160	550	.9000	2.2041	−2.197	49.50	109.1030	−2.145	.8952	.093817	0.135
180	542	.9207	2.2553	−2.452	39.57	89.2422	−2.435	.9195	.074020	0.011
200	479	.9395	2.3010	−2.743	27.23	62.6562	−2.693	.9366	.059380	0.068
250	497	.9577	2.3979	−3.120	20.13	48.2697	−3.242	.9624	.036186	0.303
300	453	.9757	2.4771	−3.693	10.74	26.6041	−3.690	.9756	.023805	0.000

$$\Sigma w = 705.12$$
$$\Sigma wx = 1396.7692$$
$$\bar{x} = 1.98090$$
$$\Sigma wl = -\ 621.56791$$
$$\bar{l} = -\ 0.881507$$
$$\Sigma wx^2 = 2801.21271$$
$$\frac{(\Sigma wx)^2}{\Sigma w} = -\ 2766.85415$$
$$34.35856$$
$$\Sigma wxl = -\ 1425.72192$$
$$\frac{\Sigma wx\,\Sigma wl}{\Sigma w} = -\ 1231.26120$$
$$-\ 194.46072$$

$$b = \frac{-\ 194.46072}{34.35856} = -\ 5.659746$$
$$a = \bar{l} - b\bar{x} = 10.329884$$
$$\hat{L} = 10.329884 - 5.659746x$$
$$\text{Log L.D. } 50 = -\frac{a}{b} = 1.82515$$
$$\text{L.D. } 50 = 66.9$$
$$\chi^2 = 5.89$$

[3] A procedure of successive approximation which may be utilized is the following. Obtain a preliminary solution by fitting graphically to the logits, yielding first estimates $\hat{L}_1$, $\hat{P}_1\hat{Q}_1$ for each x_i. Substitute for each observed value of the logit l_i a value $l_i' = \hat{L}_1 - (q_i - \hat{Q}_i/\hat{P}_1\hat{Q}_1)$ to fulfill equation (11). Make the least square solution for the substituted instead of the observed logits, using weights $n_i\hat{P}_1\hat{Q}_1$, the values $\hat{P}_1\hat{Q}_1$ being given by the first approximation. The rule of substituting a value l' for l to fulfill equation (11) furnishes another method for obtaining a value to use when the observed q is zero or 100 per cent. For zero per cent the substitute value becomes $l' = \hat{L} + (1/\hat{P}_1)$ and for 100 per cent $l' = \hat{L}_1 - (1/\hat{Q}_1)$. The method outlined in this footnote is essentially that followed by Bliss and Fisher for fitting the integrated normal curve. It can be derived by applying the approximation (11) to the conditions for a maximum likelihood solution given in (7) and (8). Applied to the logistic it is considerably more complicated than the method given in the text. Moreover it yields a higher χ^2 generally.

The comparison between the logistic and the normal curve for the examples found is given in Table II. It is seen that on the basis of the comparative χ^2 values either the results are practically the same, or there is an advantage in favor of the logistic. In no instance did the normal curve appear the better of the two. The one case in which the advantage of the logistic is appreciable, namely that of the Murray [9] male fly series, is that in which the observations were most numerous.

TABLE II

COMPARISON OF THE LOGISTIC AND THE NORMAL CURVE IN THE ESTIMATION OF DRUG POTENCY

Series	Number of dosages	Total observations	Logistic		L.D. 50		Sum of weighted squared deviation χ^2	
			a	b	Logistic	Normal	Logistic	Normal
Woodard and others [18]	8	80	5.9842	8.0459	5.54	5.52	2.77	3.01
Chen and others [2]	8	80	−15.8464	15.3321	0.0926	0.0913	7.77	8.04
Bliss, series I [1]	6	175	70.9035	39.8781	60.0	60.1	1.09	1.12
Bliss, series II [1]	6	187	74.4771	41.8241	60.4	60.1	4.85	5.03
Garwood [6]	5	200	11.0581	3.8767	0.00140	0.00142	1.75	2.69
Murry, Table I, female flies [9]	7	3,121	17.0358	7.2980	215.9	215.8	2.39	3.38
Murray, Table I, male flies [9]	11	5,495	10.3299	5.6597	66.9	66.6	5.89	11.45

It is possible that with a sufficiently large number of observations the logistic would appear generally to give the better fit. It is not to be expected that the difference will be great, since both curves are much alike. I believe that the work of fitting the logistic as given here is considerably simpler than that of fitting the normal curve by probits and maximum likelihood as advocated by Bliss and Fisher.

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THE RELATIVE EFFICIENCIES OF GROUPS OF FARMS AS SAMPLING UNITS*

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SAMPLING UNITS consisting of groups of farms are useful as a device for reducing travel costs in enumerative surveys. When such sampling units are employed, it is helpful to have some advance information regarding the loss of precision introduced by grouping. If neighboring farms are more nearly alike than farms in different locations, obviously the loss will be large. Such information can often be obtained from an analysis of data previously collected. When groups of a specified size have once been used it is possible to predict, at least approximately, the results that would have been obtained from groups of a different size.

When the grouping is such that it represents a problem in subsampling, the analysis involves no difficulties. For example, an area to be covered by a survey can be divided into N units with K farms per unit. The sample might consist of n units drawn at random with k farms selected at random from each unit for enumeration. From an analysis of variance giving the mean squares between units and within units it is possible to estimate the variance of the true unit averages, V_g, and the variance of individual farms within units, V. The variance of the mean for a sample of n units with k farms enumerated per unit is given by the equation,

$$V_{\bar{x}} = V_g(1/n - 1/N) + V(1/nk - 1/NK). \tag{1}$$

The values of V_g and V estimated from the analysis of variance can be accepted as constant for any values of n and k. The variance of $\bar{x}$ for a sample consisting of any assigned number of units, with any assigned number of farms enumerated in each unit, can thus be predicted without difficulty. Equation (1) may be modified to fit cases where k and K are not constant from one unit to another without introducing any theoretical complications.

It should be noted that this kind of grouping is not exactly equivalent to using groups of neighboring farms as sampling units; the k farms selected from a unit are taken at random from among the K that are

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present. However, in some respects the two methods of sampling are similar. Suppose that n groups, each consisting of k neighboring farms, have been used as sampling units in a survey. If there are Nk farms in the universe sampled, the universe may be regarded as made up of N groups of k neighboring farms. An analysis of variance of the data will yield an estimate of the variance of the true group averages, V_g, and an estimate of the variance of individual farms within a group, V, as in the subsampling scheme. The variance of a mean based on a sample of n such groups can be estimated from equation (1) which in this case can be simplified to the form,

$$V_{\bar{x}} = (V_g + V/k)(1/n - 1/N). \tag{2}$$

The values of V_g and V can be regarded as constants for any values of n as in the subsampling scheme. But if k is given a value other than the one actually used in the original analysis of variance, a theoretical difficulty arises. As the groups are made larger it is reasonable to expect that the value of V should also increase. The upper limit to the value of V is reached when k is equal to the total number of farms in the universe. V will then be equal to the total mean square for the finite universe sampled. The increase in the value of V must be accompanied by a decrease in the value of V_g because the total mean square in the finite universe must remain constant. So long as the values of k substituted in equation (2) do not differ too widely from the one used in the original analysis of variance, it is not likely that any serious error will be introduced by assuming that V_g and V are constant for different values of k. The relative efficiency of a sampling unit of k neighboring farms as compared with an individual-farm sampling unit is probably given fairly accurately by the equation,

$$I = \frac{V_g + V}{kV_g + V} \tag{3}$$

where V_g and V are assumed constant for all values of k.

The extent to which this approximation is justified is of considerable theoretical and practical interest. The degree of change in the values of V_g and V as k increases or decreases obviously depends upon the way the farm character under investigation varies from one locality to another. Any general law that may be invoked to describe those changes can only reflect what happens "on the average." This raises the question as to whether a general law which satisfies even these mild specifications can be found. A possible solution is suggested by the results of experimental work in agronomy.

The variability of crop yields from unit to unit on experimental plots has been studied extensively for units of different sizes. When a large unit is considered as though it were made up of several smaller neighboring units, the problem of estimating variability between units for units of different sizes on an experimental plot is identical with the one under discussion here. A thorough study of this problem by H. Fairfield Smith[1] shows that the variance of the average yield per unit for individual blocks of k neighboring units in a field is given by the equation,

$$V_{\bar{x}} = \frac{V}{k^a} \tag{4}$$

or

$$\log V_{\bar{x}} = \log V - a \log k. \tag{5}$$

In these equations V represents the total mean square of all units in the field rather than the mean square of units within blocks. $V_{\bar{x}}$ represents the variance of the group averages rather than the variance of the mean for the entire sample as in equation (1). Although derived by empirical methods, the equations appear to fit agronomic data fairly well. Data on peanut yields at North Carolina State College, which were made available to the author by the Agronomy Department, will serve for illustrative purposes.

Yields were recorded for 16 separate row segments 12.5 feet long on each of 36 rows in an experimental plot. These segments were combined to form larger units by averaging the yields from segments directly across from each other on adjacent rows. This provided 16 sets of data for each of which it was possible to measure the variance of the mean yield per segment between groups of different sizes. The 36 rows provided 2 groups of 18 segments, 3 groups of 12, 4 groups of 9, 6 groups of 6, 9 groups of 4, 12 groups of 3, and 18 groups of 2. The average variance of the group means for the 16 sets of data, expressed on a per segment basis, were computed. The relation between the variance of the group means and the size of the group is shown in Chart I. Equation (5), fitted to the data, yielded the straight regression line shown on the chart. For these data $a = 0.52720$. If there were no correlation between segments in a group, a would have been equal to unity. These results are typical of the effect of soil heterogeneity on the variability of group averages. The variances of the group means are somewhat erratic when the groups are small, but on the whole the relationship is fairly good.

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It seems reasonable to expect the variability of farm data to obey a similar law when neighboring farms are grouped into larger sampling units. Unfortunately farm data to test the relationship are not so plentiful as data from field-crop experiments, but some indication of the behavior of farm data can be obtained from results recently pub-

Chart I

Relation between variance of average peanut yield per row segment ($V_{\bar{x}}$) and number of segments per group (k) -- N. C. Agricultural Experiment Station Data.

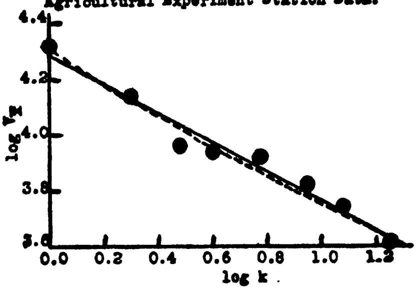
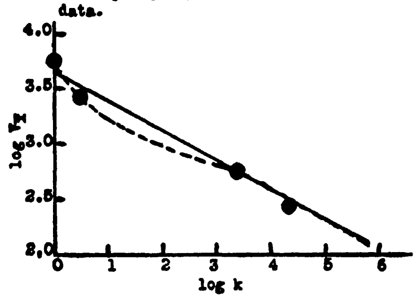


Chart II

Relation between variance of average cropland per farm ($V_{\bar{x}}$) and number of farms per group (k) -- N. C. farm data.



lished by Finkner, Morgan, and Monroe.[2] An enumeration of 4,214 farms in North Carolina, in which groups of 3 neighboring farms were used as sampling units, yielded the analysis of variance of cropland per form shown in Table I.

TABLE I

ANALYSIS OF VARIANCE OF CROPLAND FOR 217,976 FARMS IN NORTH CAROLINA

Source of variability	Degrees of freedom	Mean square
Between crop reporting districts	7	8,161,056
Between counties within districts	92	663,967
Between 3-farm units within counties	72,749	6,350
Between farms within units	145,127	4,619
Total	217,975	5,737

From this table, which is the analysis of variance of the sample inflated to a State basis, it is possible to estimate the variance of the means of groups of several sizes within the State. The total mean square is an estimate of the variance of the individual farm data for the State as a whole. Considering all farms in a crop-reporting district as a group, an estimate of the variance of the means for groups of that

[2] Finkner, A. L., Morgan, J. J., and Monroe, R. J. "Methods of Estimating Farm Employment from Sample Data in North Carolina. *N. C. Agr. Expt. Sta. Tech. Bul. 75*, 35 pp. 1943.

size is given by dividing the mean square between districts by the appropriate value of k which is given by the formula,

$$k = \frac{S(k_i) - S(k_i^2)/S(k_i)}{n - 1}. \tag{6}$$

In this equation k_i represents the number of farms in the i-th crop reporting district and n represents the number of districts. The numerical value of k, which can be regarded as an average k for all districts, is equal to 27,047. The variance of the mean cropland per farm for groups of that size is $8161056/27047 = 302$.

The mean square between the 100 counties for the State as a whole, is 1,194,064. The corresponding value of k, obtained by applying equation (6) to the county data, is 2172.8. The variance of the mean cropland per farm for groups of that size is $1194064/2172.8 = 550$.

The mean square between units for the State as a whole is 7,964. The value of k in this case is not exactly equal to 3 because the number of farms in each stratum enumerated was not an exact multiple of 3. Applying equation (6) to the farms actually present in each unit gives $k = 2.9922$. The variance of the mean cropland per farm for groups of that size is $7964/2.9922 = 2662$.

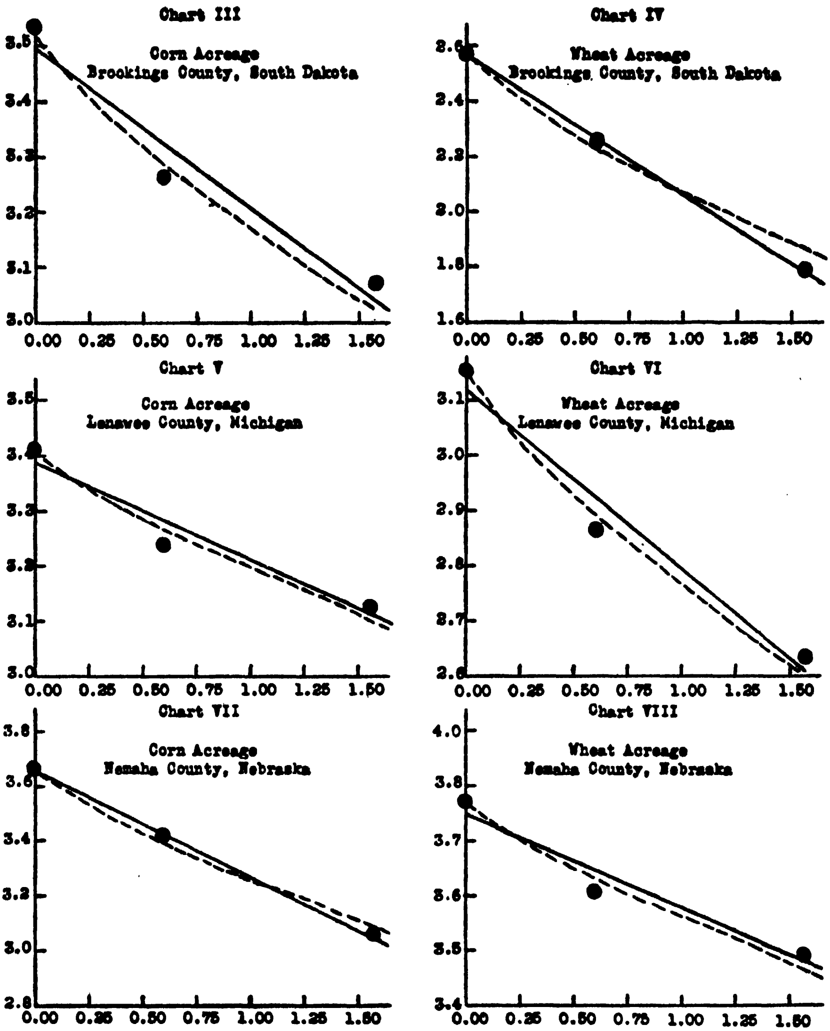
The relation between the variance of the group means and the size of the group is shown in Chart II. The relationship seems to be of the same general type as that encountered in field-plot experiments. The value of a in this case is 0.27137. However, the dispersion of the observed variances of the group means about the straight regression line for small values of k would be troublesome in some practical applications of the theory. If the first two points on the chart were all that were available, the numerical value of a would have been estimated at 0.70073 instead of 0.27137. Although some tolerance should undoubtedly be allowed for sampling fluctuations, it appears that more than sampling error is involved in this discrepancy. This conclusion was drawn after an examination of additional data from other sources.

Several years ago extensive studies were conducted by statisticians of the Bureau of Agricultural Economics in cooperation with the Work Projects Administration of New York City to investigate the efficiencies of survey sections as sampling units for the purpose of estimating crop acreages. Acreages of specified crops on sample sections were measured by planimetering those acreages on aerial photographs. The variance between individual sections, between blocks of 4 sections, and between blocks of 36 sections was computed for an area of 720 sections in each of several counties. Data for corn and wheat

acreages in 3 different counties for this study were supplied to the author by the Statistical Laboratory at Iowa State College. Charts

RELATION BETWEEN VARIANCE OF AVERAGE CROP ACREAGE PER SECTION AND NUMBER OF SECTIONS PER GROUP

Log $V\bar{x}$ plotted against Log k



showing the variability of group averages for groups consisting of 1, 4 and 36 sections within the finite population of 720 sections are shown in Charts III to VIII. In general, the curves described by the plotted variances have the same general shape as the curve described by the

first 3 plotted points in Chart II. The first plotted point is almost always above the straight regression line while the second plotted point is almost always below the regression line. This suggests that the true relationship is not represented by a straight line but by a curve that is concave upwards over the first part of the range. It was pointed out by Fairfield Smith, in his study mentioned previously, that there is a theoretical objection to the use of the straight line represented by equation (5). It was pointed out that the use of this relationship implies that the variance of individual units within groups of a specified size is a function of the size of the finite population sampled as well as the size of the group. Mathematically such a situation is indefensible. The variability of individual units within groups should obviously be independent of the size of the finite population sampled; however, it was also pointed out that, although the mean square within groups was a function of the size of the finite population, the mean square approached a limit for groups of a specified size very rapidly as the size of the finite population increased. For groups of k units the limit approached by the mean square within groups is given by the equation,

$$\text{M.S. within groups} = \frac{k}{k-1}(1 - k^{-a})V. \tag{7}$$

In this equation V does not represent the total mean square in the finite population, but should be regarded as the total mean square in the infinite population of which the finite population is itself a sample. Instead of using the straight regression line represented by equation (5), it would thus appear more logical to assume that the mean square within groups for groups of any specified size should be represented by equation (6) even for finite populations. It is a simple matter to derive an expression representing the variance of the group means from a knowledge of the mean square within groups of size k and the total mean square within the finite population, which could itself be considered a group of size N, where N is the total number of units in the finite population. Such a procedure would insure that the computed mean square within groups of a given size is constant regardless of the size of the finite population sampled. On the other hand, the variance of the group averages within the finite population would then depend upon the size of the finite population. This would be perfectly logical because the variance of group means for groups of a given size when groups are widely separated should be different from the variance observed when they are close together. When the groups are taken from a small finite population, they could be expected to be more

highly correlated with each other than when they are taken from a larger population.

When this relationship was tried, the results were disappointing. The effect of the change was to substitute a curve which was concave downwards for the straight regression line in the charts. The curve tends to be a straight line over the early part of the range and dips downward at the right extremity of the range. This obviously represents no improvement so far as describing the observed data in the charts is concerned. Fairfield Smith's field-crop data apparently followed his empirical law very closely and the refinement just described improved the relationship. However, it appears that the farm data described here follow a slightly different type of law. A study of the variability of farm data within groups of different sixes made by Jessen[8] several years ago indicated that the mean square within groups tends to follow an equation of the form,

$$\text{M.S. within groups} = Ak^b. \tag{8}$$

This equation described his data extremely well and seems to give good results when applied to the data presented here. There is a theoretical objection to using equation (8) for this purpose because it makes no provision for an upper limit to the mean square within groups as the groups become large without limit. Theoretically, the correlation between the units within a group should approach zero as the groups become infinitely large. However, the equation fits the observed data so well within the range of group sizes encountered in practice that there is no practical objection to using it. When equation (8) is used to represent the mean square within groups, the variance of the group averages for groups of size k in a finite population of N is given by the equation,

$$V_k = \frac{N}{N-k}\left[(N-1)N^{b-1} - (k-1)k^{b-1}\right]A. \tag{9}$$

The curves described by the variances of the group means plotted against group size on logarithmic scales are indicated by the dotted lines in Charts I–VIII. In Chart II the dotted line seems to pass almost exactly through the observed points in the chart. In the other charts the relationship given by equation (9) also fits the observed data better than equation (4), but the differences are not so striking. In some cases the dotted line is farther away from the last plotted point than the straight regression line. This might indicate a poorer

[8] Jessen, Raymond J. "Statistical Investigation of a Sample Survey for Obtaining Farm Facts." *Iowa Agr. Expt. Sta. Res. Bul. 304*, 104 pp. 1942.

fit but such is not the case. The observed points are plotted on a logarithmic scale and a large deviation at the upper end of the range represents only a small deviation in terms of absolute variance. On the whole, equation (9) represents the type of curve described by the observed points much better than equation (4) or the refinement introduced by Fairfield Smith.

In view of these results it is now possible to set up a procedure for the analysis of sampling schemes involving groups of farms as sampling units. For illustrative purposes consider the analysis of variance in Table II, which is a simplification of Table I.

TABLE II

ANALYSIS OF VARIANCE OF CROPLAND FOR 217,976 FARMS IN NORTH CAROLINA BASED ON A RANDOM SAMPLE OF 3-FARM UNITS FROM THE STATE

Source of variability	Degrees of freedom	Mean square
Between 3-farm units	72,848	7,964
Within units	145,127	4,619
Total	217,975	5,737

When the ordinary subsampling theory is applied to this table, the values of V_g and V are first found as follows:

$$V_g = \frac{7964 - 4619}{2.9922} = 1118$$

$$V = 4619.$$

The relative efficiency of a k-farm sampling unit as compared with an individual-farm sampling unit would be estimated from the equation,

$$I = \frac{5737}{1118k + 4619}.$$

For values of k not widely different from 3, such as a series from 1 to 10, this relationship probably provides a fair approximation. But, according to the results presented in this report, it seems more logical to use a different procedure.

The variance of group averages for groups of any size is given by equation (9). The relative efficiency of a sample consisting of grouped units with k units per group, as compared with a sample of individual farms, is obtained by dividing the quantity

$$\frac{N}{N-1}\left[(n-1)N^{b-1}\right] \quad \text{by} \quad \frac{kN}{N-k}\left[(N-1)N^{b-1} - (k-1)k^{b-1}\right].$$

All of the data needed for the computations can be obtained from the analysis of variance in Table II. The numerical value of b can be obtained from the mean square within units of 3 farms and the total mean square within the entire finite population of 217,976 farms. The process involves fitting equation (8) to the 2 points so specified. The necessary simultaneous equations are as follows:

$$\log A + b \cdot \log (217976) = \log (5737)$$
$$\log A + b \cdot \log (2.9922) = \log (4619).$$

The solution of these equations gives $b = 0.01937$. N is equal to the total number of farms in the finite population, or 217,976. The relative efficiencies of sampling units consisting of from 1 to 10 farms, as computed by the new theory, are compared with figures derived from subsampling theory in Table III.

TABLE III

RELATIVE EFFICIENCES OF SAMPLING UNITS OF GROUPS OF NEIGHBORING FARMS TAKEN AT RANDOM IN NORTH CAROLINA

Farms per units	Relative efficiency	
	Subsampling theory	New theory
	Per cent	Per cent
1	100	100
2	84	83
3	72	72
4	63	65
5	56	57
6	51	52
7	46	48
8	42	44
9	39	41
10	36	39

The differences between the relative efficiencies computed by the two methods are negligible for the range of group sizes under consideration. It is obvious that the groups would have to be made very large before the two series would diverge appreciably, but the new theory is just as easy to apply to actual data as the subsampling theory and it is highly recommended. The subsampling theory appears to be adequate so long as the group sizes under consideration do not depart too widely from the group size used in the analysis of variance from which the estimates of relative efficiency are derived. The newer theory permits valid estimates of relative efficiencies to be made for group sizes which differ considerably from the group size actually used in the original analysis of variance. The numerical value of b in the above

equations as estimated from the analysis of variance in Table II agrees very closely with the value of b obtained from all points shown in Chart II. The value of b corresponding to the dotted curve in Chart II is 0.02240 which agrees closely with the estimate of 0.01937 derived from the data in Table II alone. The use of the curve thus provides approximately the same predicted relative efficiencies regardless of which two observed points are used to establish the parameters of the curve. This is the principal advantage of using the curvilinear relationship in preference to the straight regression line which was first proposed.

SUMMARY AND CONCLUSIONS

The theory of grouped sampling units as applied to farm surveys is discussed from the viewpoint of subsampling and from the viewpoint of an empirical law developed by agronomists. The latter seems to provide the more logical basis for statistical analysis of data involving groups of neighboring farms as sampling units. The use of subsampling theory apparently introduces no serious errors if it is properly used, but the nature of the approximations involved in its application must be borne in mind. The empirical law developed by Fairfield Smith does not appear adequate for predicting the variability of group averages for farm-survey data; the empirical formula used by Jessen for establishing a relationship between group size and variability within groups leads to much more satisfactory results. The newer theory is just as easy to use as subsampling theory and is free from some of the approximations involved in that theory. Subsampling theory seems to lead to results of fair accuracy so long as the range of group sizes considered does not depart too widely from the group size used in the analysis of variance upon which the computations are based. The use of the newer theory permits extrapolation over a wider range.

COST OF LIVING ON FARMS AND PRICES PAID BY FARMERS*

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NO SECTION of the public has become as much concerned over the changes in the cost of living of the farm population as certain groups have recently over the changes in the cost of living of families of urban workers. But the subject has been more or less in the minds of farm groups, and particularly of those statisticians responsible for keeping tab on agriculture, ever since index numbers on prices paid by farmers were first issued in 1928. The series now published currently in *The Agricultural Situation* combines commodities used in farm production with those used in farm family living, and in this form of course cannot be used as a cost of living index. Moreover, this series also includes tax and interest payments, as required in an amendment to the Agricultural Adjustment Act passed in 1935. However, the monthly mimeograph release, *Agricultural Prices*, presents separate series monthly for farm production and family living and for these two combined. The February 1944 issue of *Agricultural Prices* presents these same series as annual index numbers back to 1910. The following comparisons show the general relations between these series:

	1910–14	1919	1922	1925–29	1932	1935–39	1943	June 1944
A. Farm production	100	192	139	146	109	127	163	173
B. Family living	100	210	156	161	108	123	170	177
C. A and B combined	100	202	149	155	108	125	167	175
D. Interest	100	180	260	224	188	127	105	105
E. Taxes	100	160	259	272	254	182	179	179
F. C plus D and E	100	198	164	168	124	129	164	170

It thus appears that the A and B series have differed enough at times to make highly necessary their separate use in any measure of changes in cost of living or in farm production costs. The inclusion of interest and tax payments had a very pronounced upward effect in the years from 1925 to 1935, but since 1937, due to the declining rates of interest and volume of mortgage debt, the effect of interest payments has been downward. Tax payments are still running a little higher than commodity prices.

In the final F series, farm production is weighted 37.4, family living 48.6, interest payments 7.2, and tax payments 6.8. In the C series, farm production is weighted 43.5 and family living 56.5. These weights are based on relative expenditures in the 1924–29 period.

* Prepared with assistance from the Committee on Research in the Social Sciences of Harvard University.

The publication of these series in the foregoing several combinations is necessary because of the several different uses needing to be served. The purpose of this article is to consider the suitability of these several series for several important uses, as follows:

1. Changes in farm expenses or costs,
2. Changes in the real prices of farm products,
3. Changes in the real income of the farm population,
4. Parity price and income computations,
5. Effectiveness of price control measures.

FARM EXPENSES OR COSTS

For many purposes it would be highly useful to have an index series showing changes in the prices of goods and services used in farm production. The A series listed above falls short of this need because it fails to include hired labor, veterinary and other services, and insurance, taxes and interest. One can bring in the tax and interest payments as given in the D and E series, but these are not pure price series. That is, interest payments reflect changes in the volume of debt as well as in interest rates. Similarly the tax payments reflect the changes in volume of public services (of road building, educational services and the like) as well as in the prices paid for these.

There have been many proposals of late to include farm labor wages in the prices paid series. In fact, many Congressmen thought that they had so voted when the Anti-Inflation Act was passed in October 1942. At the time that tax and interest payments were voted into the index, to have included farm wages also would have lowered parity prices,[1] and the Congressmen backed away from this proposal the moment they realized this.

The index of farm wage rates rose very fast after January 1941. By the summer of 1942 it had outdistanced the parity index and it was obvious that the spread between the two indexes would widen further. What the farm bloc wanted, therefore, was to combine the two indexes, giving as much weight as possible to the wage index, in order to derive a new yardstick for price control. The farm bloc Congressmen intended "adequate weighting" to mean including proprietor and unpaid as well as hired labor. However, the legal staff of the OPA interpreted this legislation in a highly restricted sense and very few ceiling prices were affected.[2] The House countered by passing the Pace Bill (H.R.

[1] The farm wage index stood as 103 in 1935, compared with 125 for the commodity index of prices paid.

[2] The Anti-Inflation Act was passed under pressure of the dead-line set by the President. Congressman Steagall, in presenting the report of the conference committee on the bill, interpreted the wage rate provision to include all workers on farms. Senator Prentiss Brown reported it to the Senate, however, as including only hired labor.

1408, introduced January 21, 1943), which definitely prescribed the all-labor system of weights. This would have raised parity prices about 15 per cent of the time. The Senate referred this bill back to the committee when strong opposition to it developed in the Corn Belt.

There is need also for an index of total farm expenses as well as of prices or cost-rates—that is, a Price X Quantity index. This will reflect possible substitution of machinery and power for labor, increasing use of fertilizer, and other such changes over the years. In such an index, relatives of total tax and interest payments would fit exactly.

REAL PRICES OF FARM PRODUCTS

About the time of the first world war, agricultural economists began to talk about the purchasing power of the farmer's dollar. The early calculations were made in terms of the BLS wholesale price index. Since 1928, they have more often been made in terms of the BAE index of prices paid by farmers. It is clear that the index series used for this purpose should include exactly the things for which farmers spend the money they receive from the sale of these products, in the proportions in which they distribute their purchases among them. The index series that most nearly fits this need is the over-all series including interest and taxes. Its deficiencies are its failure to include wages of hired labor and the items now omitted from the farm production price index, and certain parallel omissions in the family living index, including education not covered by taxes, medical and dental services, and personal insurance. These latter tend to lag behind commodity prices.

In two recent publications,[3] the senior author of this note undertook to compare the real earnings of labor and of agriculture by using the following wage and price series:

A. Real wages of labor and real farm prices, 1869–1943.
(Bureau of Labor Statistics wholesale price index used in converting both to a real basis) *Parity*, pp. 74 and 78; *R.E.S.*, chart 25.

B. Real hourly earnings of factory workers and real prices of farm products, 1910–43 and for more recent periods.
(Bureau of Labor Statistics cost of living used for factory workers, and Bureau of Agricultural Economics index of prices paid used for agriculture) *R.E.S.*, charts 22, 23.

The first of these charts shows clearly the familiar flattening out of real industrial wages in the years from 1895 to 1915, the sharp rise

[3] John D. Black, *Parity, Parity, Parity*, Harvard University Committee on Research in the Social Sciences, 1942; J. D. Black and Charles A. Gibbons, "The War and American Agriculture," *Review of Economic Statistics*, February 1944.

from 1919 to 1922 to a level somewhat above the secular trend, and the somewhat further net rise in real wages since 1925; and matched against this a scarcely perceptible rise in real prices of farm prices over the whole period until 1941. The second set of charts shows in more detail these divergencies in the two series since 1910–14, in terms of factory workers and all non-agricultural workers.

For some of the purposes which are served by comparisons of returns to labor and to agriculture, farm prices and hourly earning rates are the best measures. One is a return per unit of the labor performed, the other per unit of the product which embodies the labor. It is true that the product also includes some other costs, but only over a decade or two will the contribution of labor to a bushel of wheat or potatoes rise or decline according to whether the production becomes more or less labor-intensive or capital-intensive. To convert these earnings rates and unit prices to a real or purchasing power basis, however, some form of index of prices of things bought should be used. The senior author has used the BLS wholesale series in his 1869–1943 comparisons only because nothing else is available. No criticism is ordinarily raised about using a cost-of-living index with earnings of industrial labor. (The recent controversies have had to do with the accuracy of the particular series now in use.) But using the index of prices paid in this connection raises several doubts. First of all, it includes the goods used in production as well as those used in family living. Income from the sale of farm products, it is true, must pay for the things used in farm production as well as return something net to the farm population as income to spend on their living. But to throw farm expenses and net income into one system of weights assumes more of a constancy of relation between them than prevails. In the early '30s, for example, most of gross income was absorbed by expenses and little was left for family living. In 1943, in contrast, a large part of gross income went into debt payment and various forms of saving.

More important for such a comparison is the circumstance that this prices paid index represents only the price of goods actually bought. Food and fuel furnished by the farm are significant parts of real farm income. In a tentative revised index of prices paid, published in *Material Bearing on Parity Prices*[4] (section 3, table 2), "Items produced" are given a weight of 29 if valued "at prices at which the same

[4] *Material Bearing on Parity Prices* presented by Howard R. Tolley, Chief of the Bureau of Agricultural Economics, U. S. Department of Agriculture, at a hearing on parity prices and income for agriculture before a sub-committee of the Committee on Agriculture and Forestry, United States Senate. July 1941, Washington, D. C. This series was preliminary and for a special purpose and will not be extended.

products are sold from the farm." According to the BAE, data from *The Consumer Purchases Study* now available indicate that a weight of 50 should be given to food in an index including food produced and consumed as well as that bought, instead of the 35.9 in the BAE series now published.[5] If the food produced and consumed were valued at cost in the city, the weight would have been somewhere around 60.

REAL FARM INCOME

However, no comparisons in terms merely of unit prices and unit wages take care of variations in the volume of output and volume of employment. The large agricultural output of 1943 accounted for more than a fifth of the rise in farm income after 1939, and full employment for half the rise in factory payrolls. Such comparisons cannot therefore be final until they are placed on an income or net annual earnings basis. There are four farm income series which may need to be reduced to a real purchasing power basis, namely, cash income from farm marketings, net cash farm income, gross farm income, and net farm income. Earnings of hired farm labor need to be considered as well as those of employers.

For cash income from farm marketings, the combined index of prices paid for goods used in living and production must be used. This the authors did in comparing the real wage incomes of factory workers and real farm income since 1939 and since 1910 in the charts in the article in the *Review of Economic Statistics*.[6] The real farm incomes rise much the faster from 1939, but are still far below real factory earnings measured from 1910. Measured from 1925–29, the farm income series has run somewhat ahead in the last two years. The fit is not too good because of the exclusion of farm wages and the various services named above.

The net cash income series differs from the first in that cash farm expenses are deducted; hence it should be deflated by the index of prices paid for goods used in living. The last two of the income series include the imputed value of home produced and consumed food and fuel. No index series of prices paid now currently published includes these items. The values that would likely be imputed to them would, however, move along with prices received. Including them, moreover, would increase the weightings for food.

Though the net farm series includes the imputed value of home-

[5] If services were included in the index, the weighting for food would be 44; but no data are available for services in 1924–29.

[6] Real annual earnings per worker, labor and agriculture. (BLS index of cost of living and BAE index of prices paid were used to convert these series to a real basis.)

produced food and fuel, there is some question whether it provides adequately for the use of the farm dwelling. This is covered in the current index of prices paid for living only by an item called "building materials for house," given a weight of 7.4.

How well will the index of prices paid for goods used in family living fit the wages and earnings of farm labor as distinguished from the earnings of employer families? If the farm wages converted to real income in this way are wages "without board and lodging," or the imputed value of board and lodging furnished is included in the wage income, it will serve except for the general deficiencies noted. The authors proceeded on these assumptions in a chart in the *Review of Economic Statistics* article previously cited.[7] The chart resulting shows hired farm laborer's real income relatively higher than that of farm operators in 1937–39, but falling behind since. The principal objection to this procedure is that many unmarried hired men living with the farm family do not distribute their cash expenditures according to the same regimens as do operator families. Data are not available for testing the effects of these shortcomings, but they are not likely to be important.

PARITY COMPUTATIONS

It follows from the foregoing that if parity is to be figured in terms of prices, the index series used should include all the items upon which the proceeds from sales of farm products are spent. This will include hired labor surely; also insurance, taxes and interest. None of these, however, should be on a Price X Quantity basis, as at present with taxes and interest. A good case can also be made for including unpaid family labor in the weighting, and even proprietor labor. The parity ratio will then represent a balance between the cost-rates or prices of all the inputs and of all the outputs—that is, all of them except the inputs of management and entrepreneurship, which society does not ordinarily undertake to insure. Perhaps, however, it does need to consider them in the case of small-scale enterprises, especially family enterprises, whether in farm or city.

Obviously a more conclusive treatment of this subject is to work out the parity ratio in terms of net farm incomes and the prices of things bought with such incomes. This procedure has the further advantage that the changing volume of input factors and outputs can be represented in the results.

If the objective, however, is to equalize the real earnings of farm

[7] Real annual incomes of hired farm labor per worker and of farm operator families. (BAE index of prices paid for goods used in family living was employed in the conversion.) *R.E.S.*, chart 38.

people and of industrial workers, or urban workers generally, then no parity ratio in terms of prices paid will suffice—for the simple reason that prices paid by farm groups do not follow closely the wage rates, or hourly earnings, or annual earnings, of wage workers. Thus the hourly earnings of factory workers rose 12 per cent from 1921 to 1929 while prices paid by farmers for commodities rose only 1 per cent. In 1929–32, the lag was in the other direction. From 1939 to 1943, in turn, hourly earnings of factory workers rose 53 per cent while the index of prices paid for commodities rose 38 per cent.

Parity ratios as thus far computed have all been in terms of some base period as representing supposedly an equilibrium condition. There seems to be no immediate prospect of escape from this. Few of those concerned would be prepared to accept the judgment even of a U. S. Supreme Court of Statisticians as to what level of farm returns per worker equals $2,000 a year, for example, earned in our cities. Neither has it been possible thus far to shift generally to some more recent base than 1910–14.

In fact, it has not been possible even to shift to 1935–39 the base period for the weightings in the prices paid index. Not until January 1944 was it deemed safe to shift to 1935–39 the weightings for the index of prices received.[8] The turn of events at that time had brought the index series for prices received figures on the old and new base very closely in line. Shifting the series for prices paid to the 1935–39 base and making other needed changes would reduce it by somewhere around 5 points. (As usually happens, the items whose prices have fallen most have increased most in use.)[9]

Some notion as to the effect of a shift in the index of prices paid to a 1935–39 base may be obtained by examining the following parallels between the series now issued and the preliminary ones on the 1935–39 base released in *Material Bearing on Parity Prices.*

	Goods used in living		Goods used in production		Both	
	Current	Revised	Current	Revised	Current	Revised
1910–14	100	100	100	100	100	100
1925–29	161	156	146	143	155	151
1932	108	102	109	99	108	102
1935	124	120	127	115	125	119
1938	122	119	125	116	123	119
1940	121	118	124	119	122	119

If wages were included in this series, especially if they were given a weighting that included all forms of farm labor, the effect of shifting to the 1935–39 base would be submerged. Congress has not yet lost its

[8] *Agricultural Prices*, January 31, 1944.

[9] In the index series used to compute parity prices, the opposite effect is produced by the lowering of the weights for interest and tax payments in shifting to the 1935–39 base.

interest in the Pace proposal, but it is not likely to take action on it at this session.

EFFECTS OF PRICE CONTROL[10]

As is well known, the OPA was far less successful at the outset in holding in line the prices of farm products and of food than those of most other commodities. Not until the late spring of 1943 did the farm price controls take hold in earnest. The index number of prices received by farmers was 196 in April of this year as compared with 197 a year earlier. By April 1943 the farm price index had risen 90 points from 107 in 1935–39, while the non-agricultural wholesale price index was rising only 34 points.

The general effect of these differences in behavior of prices of the two groups of products is to make gross farm income advance more rapidly than farm expenditures and thus increase net farm income. This result appears clearly enough so long as one deals with the problem in terms of aggregates, but it tends to be concealed in computations of parity based on index numbers. The reason for this is that the index numbers of prices paid include prices of farm products themselves used in production, and also of food purchased for farm family living. This is clear from the weightings used in these index numbers. Those for the production index are as follows:

	Percentages
Feed	27.0
Machinery	11.2
Automobile (share used in farm production) and trucks	12.0
Tractors	3.2
Fertilizer	8.6
Building and fencing materials	15.9
Equipment and supplies	18.6
Seed	3.6

The feed and seed in this list, weighted 30.6 per cent, are themselves farm products, and tend to move in unison with, and roughly in the same amplitude with farm prices themselves. If these are omitted, the index of prices paid for goods used in production would be affected as follows:

	1939	1940	1941	1942	1943
Prices paid for goods used in production	100	102	107	122	134
Feed	100	110	118	147	176
Prices paid for goods used in production excluding feed	100	100	105	117	123

The OPA can indeed say that if feed prices had been kept down to the level of other goods used in farm production, the index of prices paid for agricultural production goods rose only 21 points instead of the 34 appearing in the current index. Similarly, food prices, making

[10] Dr. A. G. Peterson of the BAE supplied the several series with food, feed and seed omitted.

up over a third of the family living index number, move in unison with farm prices and also with farm income, except for the vagaries of the weather.[11] Those interested in showing how effective the OPA has been in keeping down agricultural costs like to point out how little costs of living of farm families have risen if food is excluded. And food prices should be excluded, they infer, because their increase imposes no burden since the farmers have also received the benefit of this rise in higher prices of food products sold. Excluding food from the index of prices paid for goods used in family living has the following effects:

	1939	1940	1941	1942	1943
Cost of living, BLS	100	101	102	117	124
Prices paid for goods used in family living bought by farmers, BAE	100	101	109	128	142
Prices paid, food bought by farmers, BAE	100	100	112	134	152
Prices paid for goods used in family living bought by farmers with food excluded	100	101	110	128	138

Thus the 1943 index number on a 1939 base would be 138 in place of 142 if food prices were excluded. The farm family's cost of living would still appear to have risen 38 per cent as compared with 24 per cent for the city worker's. One reason for this difference is that rents, which figure largely in the cost of living index, have been held down rather effectively, and the same item appears in the prices paid index for the most part only as a small item for building materials. Both clothing and house furnishings have increased more in the BAE than in the BLS indexes. The absence of services in the BAE index is still another reason.

If the two parts of the index, goods used in farm family living, and goods used in farm production, are combined, the results are as follows:

	1939	1940	1941	1942	1943
Prices paid by farmers for all goods bought, BAE	100	101	108	126	138
The same excluding food, feed and seed	100	100	108	122	129

Thus after exclusion of the three items which move more or less in unison with farm prices, the index rises 29 points from 1939 to 1943 instead of 38. This 29 can be compared with the 24 point rise in the BLS cost of living series, but of course the agricultural series includes production costs as well as living costs.

These differences are indeed significant as an analysis of OPA price control. Of the $1.0 million which farm expenditures increased in

[11] The weightings in the index now currently published for commodities used in farm family living are as follows:

	Percentages		Percentages
Food	35.9	Supplies (fuel, soap, auto supplies, etc.)	14.1
Clothing	30.4	Building materials for house	7.4
Furniture and furnishings	5.9	Automobiles (share used for living)	6.3

1942–43, while cash farm receipts were rising $3.8 million, about a third consisted of higher prices for food, feed and seed. The effect of this is to give a 12-point instead of a 7-point increase in prices paid and to effect computations of parity prices in the same proportions.

On the other hand, it must be pointed out that if one's concern is with getting a measure of change in real income, the point raised by the OPA has no meaning. If the rise in farm prices raises farm incomes, it also raises the prices of the foods which must be bought with that income, and should appear on both sides of the ledger. The fact that some of the rise in prices of farm products is reflected promptly in higher prices for goods used in living and production does not call for throwing these items out of the index of prices paid when that index is being used in calculating real farm income. On the contrary, they must be left in unless some method can be devised for removing receipts arising from the final sale of these to farmers from the other side of the ledger. This will be true whether farm prices or farm income per worker is being used as a real or money income.

ON THE SUMMATION OF PROGRESSIONS USEFUL IN TIME SERIES ANALYSIS

By Joseph A. Pierce
Atlanta University

It was pointed out by F. A. Ross[1] that summations of progressions find useful application "in time series analysis where straight lines and more complex curves are fitted as secular trends." Ross presented formulas for the first six powers of the first t natural numbers and of the first t odd natural numbers. He also gave supplementary formulas to be used in fitting a secular trend when the mean of time is taken midway in the time series. These formulas were derived by elementary algebra methods which require a separate and individual derivation for each formula.

The purpose of this paper is to present recursion formulas for sums of progressions which may be used to extend easily the list of formulas given by Ross to include those of higher order.

The series to be considered are

$$\sum_{x=1}^{n} x^r = 1^r + 2^r + \cdots + n^r, \tag{1}$$

$$\sum_{x=1}^{n} (2x-1)^r = 1^r + 3^r + \cdots + (2n-1)^r, \tag{2}$$

$$\sum_{x=1}^{n} (2x-n+1)^r = (1-n)^r + (3-n)^r + \cdots + (n-3)^r + (n-1)^r, \tag{3}$$

$$\sum_{x=1}^{n}\left(\frac{2x-n+1}{2}\right)^r = \left(\frac{1-n}{2}\right)^r + \left(\frac{3-n}{2}\right)^r + \cdots + \left(\frac{n-3}{2}\right)^r + \left(\frac{n-1}{3}\right)^r, \tag{4}$$

for $r=0, 1, 2, \cdots$. We may represent each of these series by

$$S_r = \sum_{x=1}^{n} [a + (x-1)h]^r, \qquad r = 0, 1, 2, \cdots$$

for proper values of a and h.

[1] This Journal, March 1925, pp. 75–79.

We denote the generating function of S_r by

$$G(\theta) = S_0 + S_1\theta + S_2\frac{\theta^2}{2!} + \cdots + S_r\frac{\theta^r}{r!} + \cdots . \qquad (5)$$

Since, for $y=a+(x-1)h$,

$$\sum_{y=1}^{n} e^{y\theta} = \sum_{y=1}^{n}\left[1 + y\theta + y^2\frac{\theta^2}{2!} + \cdots + y^r\frac{\theta^r}{r!} + \cdots\right]$$

$$= S_0 + S_1\theta + S_2\frac{\theta^2}{2!} + \cdots + S_r\frac{\theta^r}{r!} + \cdots$$

it follows that

$$G(\theta) = \sum_{x=1}^{n} e^{[a+(x-1)h]\theta}. \qquad (6)$$

The right member of (6) may be evaluated by the formula for the sum of a geometric progression and we obtain

$$G(\theta) = e^{a\theta}\left[\frac{e^{nh\theta} - 1}{e^{h\theta} - 1}\right]. \qquad (7)$$

By equating the right member of (5) to the right member of (7), we obtain

$$S_0 + S_1\theta + S_2\frac{\theta^2}{2!} + \cdots + S_r\frac{\theta^r}{r!} + \cdots = e^{a\theta}\left[\frac{e^{nh\theta} - 1}{e^{h\theta} - 1}\right]. \qquad (8)$$

Expanding the exponential terms of the right member of (8) and then equating, the coefficients of

$$S_r + \frac{rh}{2!}S_{r-1} + \frac{r^{(2)}h^2}{3!}S_{r-2} + \cdots$$

$$= a^r n + rha^{r-1}\frac{n^2}{2!} + r^{(2)}h^2a^{r-2}\frac{n^3}{3!} + \cdots \qquad (9)$$

which is the recursion formula for S_r. Formula (9), for proper values of a and h will yield the sums desired but it is considerably less laborious to use individual recursion formulas for each sum.

If we take

$$S_r = \sum_{x=1}^{n} [a + (x - 1)h]^r$$

to represent equation (1) then $a=h=1$ and therefore (8) becomes

$$S_0 + S_1\theta + S_2\frac{\theta^2}{2!} + \cdots + S_r\frac{\theta^r}{r!} + \cdots = \frac{e^{n\theta} - 1}{1 - e^{-\theta}}. \qquad (10)$$

Expanding the exponential terms of the right member of (10) and equating coefficients of $\theta^r/r!$, we obtain

$$\frac{(r+1)^{(1)}}{1!} S_r - \frac{(r+1)^{(2)}}{2!} S_{r-1} + \cdots + (-1)^{i+1}\frac{(r+1)^{(i)}}{i!} S_{r-i+1} + \cdots = n^{r-1}$$

which is the recursion formula for the sum of the powers of the first n natural numbers.

Similarly, recursion formulas for the sums represented by the equations (2), (3) and (4) are respectively

$$\frac{(r+1)^{(1)}}{1!} S_r + \frac{(r+1)^{(3)}}{3!} S_{r-2} + \cdots + \frac{(r+1)^{(2i-1)}}{(2i-1)!} S_{r-2i+2} + \cdots = 2^r n^{r+1},$$

$$\frac{(2r+1)^{(1)}}{1!} S_{2r} + \frac{(2r+1)^{(3)}}{3!} S_{2r-2} + \cdots + \frac{(2r+1)^{(2i-1)}}{(2i-1)!} S_{2(r-i+1)} + \cdots = n^{2r+1}$$

and

$$\frac{(2r+1)^{(1)}}{1!} S_{2r} + \frac{(2r+1)^{(3)}}{2^2\,3!} S_{2r-2} + \cdots + \frac{(2r+1)^{(2i-1)}}{2^{2i-2}(2i-1)!} S_{2(r-i+1)} + \cdots = \frac{n^{2r+1}}{2^{2r}}$$

COMMITTEE ON NOMINATIONS

President Walker has appointed the Committee on Nominations for 1944.

The Committee consists of

Henry B. Arthur, *Chairman*
Swift and Company
Chicago, Illinois

F. Leslie Hayford
General Motors Corporation
New York City

S. S. Wilks
Princeton, New Jersey

The report of the Committee will be published in the November BULLETIN.

BOOK REVIEWS

GLENN E. MCLAUGHLIN, *Review Editor*

Excess Profits Taxation, by Kenneth James Curran. Washington: American Council on Public Affairs. 1943. vii, 203 pp. $3.00.

This volume is essentially a history of excess profits taxation in the United States. As such, it gives evidence of careful research, is well documented, and apparently accurate.

A particularly useful chapter is that entitled, "Revision by Interpretation, 1918." In this chapter, and elsewhere, the author gives fuller recognition than is customary to the magnitude of the task that fell on the group headed by Dr. T. S. Adams which was called upon to formulate regulations under the Act of 1917; and to the combination of skill and courage with which that work was performed.

After quoting and concurring in contemporary tributes to the value of this work, the author continues cynically: "It was not until 1926 that the inevitable Congressional condemnation occurred." It may well be that the condemnation would have been less severe, and certainly it would have been less justified, if the views of the group as to the termination of the tax had also been followed. They favored the creation of a small commission to dispose of the cases on broad lines. They held that quick disposal of the cases would have a healthy effect on the economy generally, and that, while the war feeling was still alive, settlements could be made that would be acceptable to taxpayers and yet more productive to the revenue than would be the result of long, drawn-out controversies. The millions, refunded to the United States Steel Corporation ten years after the war ended, are but a single illustration of the foresight then displayed but not availed of.

The fact that under the designation "Excess Profits Taxation" two essentially different types of taxes may be and have been levied is brought out in the text. In one case, the levy is sought to be made on the excess brought about by the emergency over profits of normal times; in the other, on an excess over what is thought to be a reasonable rate of return. The author points out that both were combined in the laws of 1917 and 1918. He comments that: "For the sake of simplicity, it would have been better to employ invested capital alone in 1917 rather than to have permitted pre-war profits to play the very minor role that they did." However, the best opinion of the time was that the pre-war profits should be given great weight. If the two principles had not been embodied in the Act of 1917, it might have been difficult to get them recognized in the Act of 1918.

The introduction of the idea of invested capital immediately raises the question whether that capital should be measured in terms of cost or value, and whether it should be the capital invested in the corporation or the capital invested in the enterprise carried on by the corporation that should be re-

garded as significant. These questions have assumed a new importance with the development of the law relating to tax-free reorganizations and the introduction in the field of public utility regulation of a concept of cost to the first person that devoted property to the public service.

The historical narrative contained in the volume is accompanied by some comment on the problems presented, but the discussion is not exhaustive and, particularly, little or no effort is made to compare American and foreign concepts and experience. The value of the volume is, therefore, limited, but within its scope it appears to be authoritative.

GEORGE O. MAY

New York City

National Product, War and Prewar, by Simon Kuznets. New York: National Bureau of Economic Research, Inc. 1944. 54 pp. 50 cents.

In this paper Dr. Kuznets suggests a solution to the problem of measuring gross national product in real terms during the period when the economy shifted from peace to war output. While many economists will question his conclusion, that the national product in real terms increased 47 per cent from 1939 to the first half of 1943, most will agree that he has rendered a distinct service in stressing the valuation (weighting) aspect of real output measures.

Briefly stated, the method involves deflating by means of price indexes those segments of the GNP which measure changes in the dollar volume of nonwar type products, the physical characteristics and terms of production of which have not been greatly altered during the 1939–1943 period. In the case of war output—finished munitions and war construction—however, the author is impressed with the extreme difficulty of deriving a price index for goods, the composition and design of which have been greatly changed during the period. Further, he regards as important the fact that in the prewar period not only was the output of munitions extremely small relative to total output, but also that some of the industries such as aircraft and shipbuilding were immature, producing in small volume generally on a custom basis, however mature in point of time. In both cases Dr. Kuznets argues that the introduction of mass production techniques associated with a large volume of output as well as rapid advances in product design have so lowered unit costs as to grossly inflate a measure of real output weighted with prewar prices of munitions and nonwar goods. While this distortion is relatively small in the prewar years it cannot be dismissed when munitions' output absorbs a large share of the country's economic effort.

As a solution to the problems of deflation and relative valuation of the munitions component of GNP, Dr. Kuznets first derives a measure of the real input of resources which presumably neglects changes in the efficiency of their use. Basically, this series is a combination of the contribution of labor as measured by manhours worked and the contribution of capital and enterprise as measured by minerals used in producing munitions. Each series is

weighted by the value of its contribution in 1939. To answer the question, how adequately does an index of minerals consumption measure the real contribution of capital and enterprise, implies the ability to distinguish in the total return to capital that part arising from productivity changes, since this appears to be included in the assumptions regarding the efficiency of resource use. Similarly, this is true in using manhours as a measure of real labor input. When we add to this the assumption that the contribution of government is equal to prewar corporate income taxes extended for later years by an index derived from manhours and materials, we are in the position of Alice facing Humpty Dumpty.

In translating the measure of resource input into terms comparable with the other segments of GNP in 1939 prices, the attempt is made "to value war output not at actual 1939 prices . . . , but at prices it would have fetched in 1939 had it been produced under conditions comparable to peacetime . . . [with] the efficiency of resource input characteristic of comparable peacetime industries grown to maturity without the urgent haste and waste of wartime."

Taking the position that comparable resources devoted to war relative to nonwar goods are compensated at rates not corresponding to the efficiency of their use, Dr. Kuznets assumes that the efficiency of resources devoted to munitions in the first half of 1943 relative to similar resources used in the metals, petroleum, chemical and construction industries in 1939 varied between 0.8 under assumption *a* preferred by him, and 1.3 under assumption *c*. An increase of two-thirds is allowed in the efficiency of munitions production relative to nonwar output over the period. This combined with assumption *a*, regarding the level of relative efficiency in the munitions and nonwar sectors of GNP, implies that in 1939 the efficiency of resource utilization by the "war industries" in producing munitions was but half that of the same group of industries producing nonwar output.

This is in line with Dr. Kuznets' position that the basis of valuation of war goods is substantially different from that extant in the "competitive" nonwar sector of the economy. Noting that the assumptions concerning relative efficiency are "illustrative" readers may well heed the author's warning to view the results in the same light.

John M. Crawford

Washington, D. C.

Analyses of Minnesota Incomes, 1938–39, by Roy G. Blakey, William Weinfeld, James E. Dugan and Alex L. Hart. Minneapolis: The University of Minnesota Press. 1944. xxvi, 367 pp. $5.00.

This is a collection of three monographs which analyze data from the Minnesota income study, together with an introduction and excellent general summary by Professor Blakey.

In the first study William Weinfeld relates averages and distributions of individual earnings (wages, salaries, and entrepreneurial net income) in

Minnesota to the earner's sex, age, occupation, and weeks of employment, and to the size of community in which he resides. He also relates income of families and single individuals from all sources to various characteristics of these economic units. Cross-classification of principal variables is undertaken in each case. The author's style and disinclination to seek explanations underlying the given data render an intrinsically interesting subject dull reading.

James E. Dugan's analysis of "Housing as Related to Income" is a noteworthy achievement. His goal is discovery of the factors which determine the demand for housing and the fashion in which they operate. The principal investigations relate extent of home ownership and rent paid by renting families to such variables as income, size of community, occupation and family composition. Income effects are successfully isolated from the influence of his other determinants. Information is drawn from Housing Census and Real Property Inventory data, as well as from the Minnesota Income Study sample.

This author sensibly accepts "a fairly regular and consistent relationship between two variables" as sounder basis for reliance upon relationship than the χ^2 or other statistical tests of significance. Hart, in the third section of the book, appears to be of an opposite opinion on this point (p. 252, but see also p. 257).

Sound organization, investigations beyond the given data for explanation of observed relationships, effective use of charts, and novel conclusions enliven Dugan's section of the book.

Alex L. Hart assays data collected in the Minnesota field canvass by three types of test: comparison of income from covered employment reported by 232 earners in the field survey with their earnings as reported by employers to the Minnesota Unemployment Compensation Division; comparison of certain characteristics of the farm sample with the Census of Agriculture; and, by the method of subdivision of the sample, an analysis of randomness from internal evidence. None of the tests is reassuring for schedule-interview surveys. Most disturbing, because least subject to rectification, are the wide errors shown by the first test to exist in the basic data collected in the field canvass. Evidence of a definite downward bias in the field survey (as contrasted with a random distribution of errors of reporting) must be qualified by the consideration that there are 22 chances in 1,000 that the observed bias would arise from chance. A moot point is the extent to which Hart's criticisms of the Minnesota data undermine Weinfeld's and Dugan's analyses. The author offers several suggestions for improving sampling procedures in future surveys, but "questions the wisdom" of attempting to secure income data by the schedule-interview method.

This volume, demonstrating the value of analysis of data by the technicians who prepare them, suggests that such analysis by the technical staffs should more often follow large-scale statistical investigations.

EDWARD F. DENISON

Washington, D.C.

The Displacement of Population in Europe, by Eugene M. Kulischer. Montreal: International Labour Office. 1943. iv, 171 pp. $1.50.

If Dr. Kulischer had reported back to the sponsors of his project that a definitive report on the displacement of population in Europe was not feasible, he would have been correct. The kinds of data essential for such a report are not available, if they exist. It is to Dr. Kulischer's credit that he went through vast masses of fugitive materials to secure the bits and pieces of information from which a systematic history of the war migrations could be outlined. The task of compilation and analysis meant checking and cross-checking, recognizing false propaganda reports, evaluating the reasons why a particular figure was allowed to get into print, and separating out those figures that are usable from those that are not. The results of the survey are necessarily preliminary and provisional, as the author himself recognizes. The report is of great service to all who are concerned with a numerical statement of the displacement of population in Europe. The student who wishes to go further will not need to repeat his systematization of the mass of spotty, contradictory, and generally inadequate data. Sources are cited throughout.

The survey begins with the migration of the German peoples; first, the transfers of German minorities for the purpose of establishing ethnically pure States, then the efforts to settle Germans in the conquered territories, and, finally, the movements of Germans out of Germany as colonists or as officials and employees. Except for Poland, Germany has had a larger rate of population displacement since 1939 than any other country in Europe. Chapter II deals with the movements of non-German populations; the pre-war refugees, the refugees fleeing from advancing armies, the movements of people other than Jews who were shifted about in accordance with the changing policies in conquered territory, and the expulsion and deportation of Jews, the territories of destination and methods of confinement, the new ghettos and forced labor camps. The number of Jews expelled and deported from Germany and countries under German occupation or control between 1939 and early 1943 is estimated at 1,080,000.

The third chapter deals with the mobilization of foreign labor by Germany, the extent of emigration of foreign workers into Germany before the war, and the transfers of foreign workers since then—war prisoners, voluntary civilian workers, and civilian workers forcibly brought into the country.

The report concludes that more than 30,000,000 of the inhabitants of the continent of Europe have been "transplanted or torn from their homes since the beginning of the war." Such a figure takes no account of the men in the armed forces or the Todt organization. At best it includes only a fraction of the transfers of workers within the frontiers of individual countries, such as the people who have left cities subjected to bombing, the people who are moved about from place to place in labor battalions, etc.

The data are presented by country and, insofar as possible, in tabular form, supplemented by a number of useful maps.

CONRAD TAEUBER

Bureau of Agricultural Economics

Unemployment Compensation Experiences of Beneficiaries in Columbus, Ohio: 1939–1940, by Rose L. Papier. Columbus: The Ohio State University, The Bureau of Business Research. 1943. xiii, 82 pp. $1.50.

The introductory statement: "Unemployment has long been recognized as a major hazard in the lives of workers" emphasizes the insurance aspects of unemployment compensation, namely, the pooling of funds to cover the risk of wage loss through unemployment. An interesting array of unemployment compensation objectives follows. These range in scope from speculations emanating from earlier efforts of the State Assembly to draft an unemployment insurance law, to Haber's criteria for evaluating unemployment compensation systems. The former views consider unemployment insurance as an economical means of meeting unemployment costs by stimulating efforts to stabilize employment; whereas, the latter points up the virtues of a completely Federalized system with generous benefits for all.

It was believed that some indication of the effectiveness of the Ohio Unemployment Compensation Law could be obtained through a detailed analysis of information from records essential for benefit payments, although the limitations of such sources for measuring the workers' hazard to wage loss through unemployment were clearly recognized. Some attempt to improvise on the deficiencies of the beneficiaries' records for measuring the hazard of unemployment was attempted through the use of the concepts "exhaustion rate" and "the potential period of non-compensated unemployment." Although the exhaustion rate represents the proportion of all beneficiaries who draw the total number of weeks of benefits to which they are entitled, there is insufficient information to indicate the cyclical impact on this ratio of increasing the maximum number of weeks allowable under the benefit formula. Likewise, the potential period of non-compensated unemployment cannot account for reemployment. The ability of these measures to indicate the effectiveness of an unemployment compensation program is very restricted.

In view of these limitations, and the difficulties encountered in any attempt to get a numerical measure of adequacy, an excellent statistical analysis has been made of the benefit payment experience. Characteristics of beneficiaries' weekly benefit amounts, exhaustion rate, non-compensable period, and period of reemployment of beneficiaries with non-exhausted benefit rights were dealt with in detailed tabulations. Beneficiaries who were disqualified—those required to serve a longer waiting period and receive reduced potential benefits—were segregated from those who were not disqualified. Other classifications of beneficiaries were obtained through occupational and industrial groupings. There are 17 tables in the appendix which thoroughly exploit various possible classifications of beneficiaries by sex, age, weekly benefit amount, total amount of benefits received, months before permanent reemployment for beneficiaries not exhausting rights to benefits and potential months of non-compensable unemployment for beneficiaries exhausting rights to benefits.

Although an excellent analysis of the data available from claimants' records has been made, only a small part of the total picture of the workers' risk to unemployment for a short period has been revealed. If this study were expanded to include a survey of the duration of unemployment and employment of workers in Columbus, Ohio, at the time benefits are paid, a more complete appraisal of the adequacy of the Ohio Unemployment Compensation Law could be made. Duration data similar to that obtained in Croxton's surveys of unemployment and employment in Columbus, Ohio, for the years 1920 through 1924 would be very useful for this purpose.

Harry J. Winslow

New York State Department of Labor

The Movement of Factory Workers: A Study of a New England Industrial Community, 1937–1939 and 1942, by Charles A. Myers and W. Rupert Maclaurin. New York: John Wiley & Sons, Inc. 1943. viii, 111 pp. $1.50.

This study, undertaken by the Industrial Relations Section of the Massachusetts Institute of Technology, is especially valuable as a contribution to method. The project sought to analyze "the interactions of the demand and supply of factory labor in an entire industrial community." It emphasized the movement of factory workers within a local labor market, rather than from one place to another. Two adjacent cities were selected whose total population numbered some 64,000. In these centers about one-half the total employment was in manufacturing industries. Wage levels were not high, and unionism had never been a factor until 1941–42. The period of the study was principally 1937–39; a re-study was made in 1942.

A notable feature of the undertaking was its coverage. Included were some 16,000 workers from firms employing three-fourths of all factory employees in the two cities. For this group, work histories and related data were secured from company records. There was a main sample of 1,539 workers who were laid off or left their jobs voluntarily in the period. For these, more complete data were available; and for a still smaller sample of a few hundred additional information was obtained by personal interview.

It was possible to record information from company records on so large a number as 16,000, because the investigators used the microfilm process. All but a few of the business firms who were approached permitted their records to be photographed. The investigators found this method advantageous on several scores: it caused a minimum of disturbance to business office routine; they were able to collect all the information available very rapidly; and in the material they had a permanent record which could be called upon for detailed analysis as occasion arose.

The findings are of more than usual interest, as mention of a few points will suggest. There was a high labor turnover in this industrial area. More than 70 per cent of workers studied were without steady employment during 1937–39. Less than 15 per cent of these moved among the principal facto-

ries; the large majority "disappeared"—became unemployed or moved into non-factory jobs. About 30 per cent of the moves made were voluntary; 70 per cent were "forced moves," due to layoffs or discharges. Even in the wartime market of 1942 forced moves still predominated. A strong tendency was noted for workers to move between industries and firms located in the same neighborhood. The movement in the direction of higher-wage firms was not very great. Noteworthy barriers to free movement were discovered on both the demand and supply sides of the labor market; of special interest in this particular community was a "gentleman's agreement" among employers not to hire away from one another, or attempt to outbid, although this had given way to some extent in 1942 under pressure of war contracts. Other interesting contrasts between 1937–39 and 1942 were noted. A main limitation of the study, say the authors, was lack of data on the experience of certain groups of workers, such as those who moved out of factory work into non-factory jobs or unemployment.

A further limitation, one that is unavoidable in such studies, lies in the special characteristics of the particular industrial community investigated. If the same methods, so successfully used here, could be applied to other types of local labor markets, even those much larger and more complex, it would be a valuable contribution indeed. The study is to be highly commended and should be read without fail.

KATHARINE DU PRE LUMPKIN

Institute of Labor Studies
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Earnings and Social Security in the United States, by W. S. Woytinsky. Washington: Social Science Research Council, Committee on Social Security. 1943. xiii, 260 pp. $2.50.

This book represents a comprehensive analysis of wages and earnings as related to all the more important factors affecting their level and distribution. Relationships and comparisons are all presented in brief summary tabulations and charts interspersed throughout a smoothly flowing text. The result is a readable volume for those primarily interested in description and a well-organized reference for those having occasion to make use of wage or earnings data for analytical or statistical estimating purposes. The materials presented will be found particularly useful for those interested in making analyses of the probable impact of changes in social security programs, of minimum wage provisions, and of income and other tax programs based on wages or earnings.

Data collected through the operation of the old-age and survivors insurance program constitute the primary source of the statistical materials analyzed, although other sources, such as the wage and hour studies of the Bureau of Labor Statistics and the income estimates of the Department of

Commerce are used where pertinent—particularly for comparison with old-age and survivors insurance data.

Much of the verbal analysis and conclusions drawn is directed toward problems related to the administration, policies, and provisions of the social security program. Particular attention has been given by the author to pointing up the materials for use in estimating long-time trends in coverage, costs, and trends.

The following is a brief outline of contents:

1. The introduction consists of a brief description of the statistical methods used in the analysis of wage and earnings distribution and their inequalities.

2. The number and earnings of wage and salary workers covered by the social security program are compared with the total number of wage and salary workers and their earnings. Factors analyzed include variations as between income levels, industry, and state.

3. Levels, inequalities, and variations of wages for families and individuals are related to such factors as industry, occupation, age, sex, color, state, continuity of employment, and whether covered or not by the social security program.

4. The long-range trend in per capita income and wages is analyzed and related to long-range estimates of benefits and contributions under the old-age and survivors insurance program. Long-range trends are also analyzed in terms of relationship between wages, prices, and national income.

5. The final sections of the book analyze old-age and survivors benefits by type of payment (to retired workers, to their wives and widows, and to their children under 18) and by state; and relate the economic status of families and individuals at different stages in their life cycle to levels of earnings and the need for social security.

Emmett H. Welch

War Manpower Commission

The Mining Industries, 1899–1939: A Study of Output, Employment and Productivity, by Harold Barger and Sam H. Schurr. New York: National Bureau of Economic Research, Inc. 1944, xxii, 452 pp. $3.00.

This study constitutes an addition to the three volumes previously issued by the National Bureau of Economic Research on output, employment and productivity in American manufacturing and agriculture from 1899 to a recent prewar year. New indexes are made available which are coordinate with those for manufacturing and agriculture. Although the presentation of these indexes is the chief purpose of the volume, somewhat extensive collateral information is given on resources, discovery rates, production techniques and consumption of minerals.

Weights assigned in the various indexes of output are analogous to those in the Federal Reserve index, and results are similar. Rather close agreement

with the earlier Edmund E. Day index also is recorded for the period of overlap, 1899–1923. On the other hand, the departure from the National Research Project index is wide, the NBER index showing a much stronger upward trend. This difference is due to the use of employment weights for output in the NRP index, which assigns a heavy weight to the weak series, such as coal mining, whereas the value added basis of the NBER index gives greater importance to the strong series.

It will be a surprise to economists who have assumed that minerals output is a declining factor in the economy that the minerals index in the 40-year period ending with 1939 rose almost as rapidly as the manufacturing index and far outdistanced the agricultural index. Production of petroleum and natural gas and certain non-metallic metals, such as sulfur, potash, bromine and borates, accounts principally for the strength of the minerals index. Metals output grew only a little more than one-third as much as total fuels output in the 40-year period. Fuels are less important as a direct part of the product in manufacturing than as a source of energy for heat and power. Imports and exports of crude and semi-manufactured minerals are a small share of domestic output. It may still be true, therefore, that minerals going into manufacturing as a part of the product are a declining ingredient in the end-product valuation.

Moreover, the border line between mining and manufacturing is extremely important. It happens that the definition of manufacturing includes all processes except a very few such as cleaning and beneficiation of minerals. A good case can be made for including smelting and refining in minerals production. The basic materials for multiple uses in manufacturing are not the crude minerals so much as the refined minerals. Competition between bauxite or other crude sources of aluminum and iron ore, for example, is much less direct than between refined aluminum and pig iron or raw steel. The same is true of competition among plastics, metals and the whole gamut of other minerals. If we chose to count smelting and refining with mining instead of with manufacturing, an element of growth retardation would be taken away from manufacturing and added to mining. Trends in the metal industries would be especially affected.

Employment data utilized in the volume are generally not the numbers of persons employed. What is usually meant is working time in terms of mandays or manhours. This usage is so prevalent throughout the study and data on numbers employed are so sparse that the title would have been more accurate had it referred to working time instead of employment. Much investigation remains to be done on the number of individuals engaged in mining industries. Basic information on this important subject is not now satisfactory. For even such a leading industry as petroleum, basic series are either lacking or are far from reliable. Mining industries have a larger share of part-time and intermittent labor than manufacturing. Nevertheless, in conformity with the impression conveyed by the title of this study, averages of employment comparable with those of the Census of Manufactures could be shown more freely.

One should note that, in the study, productivity merely refers to output per unit of working time and does not necessarily indicate potentialities. Certain mining practices, for example, the drilling of shot holes by hand and the loading of fixed quotas of cars in the anthracite industry, are admittedly inefficient. In mining as in most other industries, a gap usually exists between the actual and the best practice. A shift from hand to mechanical operation would tend to increase the spread. Productivity data based on actual output per unit of labor time do not allow for such technological lags.

In agreement with the policy of NBER, the volume undertakes to present facts with a cautious theorizing as to implications. Anyone who has delved into the comparatively abundant but loosely coordinated and inconsistent mining data will recognize the careful workmanship that has gone into assembly and presentation of the data. As a factual study, the volume unquestionably is without a rival in the mining segment of our economy.

Wilbert G. Fritz

Program Bureau
War Production Board

Railway Traffic Expansion and Use of Resources in World War II, by Thor Hultgren. New York: National Bureau of Economic Research. 1944. 31 pp. \$.35.

Railway Wage-Rates, Employment and Pay, by John L. McDougall. Toronto: Longmans Green & Company. 1944. 34 pp. \$.50.

These two pamphlets treat various phases of railway experience with special reference to the war period. Mr. Hultgren's paper is primarily a straightforward account of the growth of wartime railroad traffic and the changes in the various operating and revenue measures which accompanied it. It indicates the means by which large increases in business were handled with much smaller increases in the plant, manpower, and fuel devoted to it. The increased utilization obtained from equipment is clearly demonstrated and some of the methods used to obtain such enhanced productivity are touched upon. The paper aims, however, more at exposition of the results than their explanation. No attempt is made to go into the technical background of operating methods, equipment maintenance, etc, which have contributed so largely to the results recorded. The treatment of the present war experience is enhanced by comparison with World War I. Charts highlight the behavior of certain indexes of railroad performance, showing, for example, the limits beyond which number of cars per train do not increase, though trainload continues to grow at a much reduced rate as average carload increases. The paper should serve as a most convenient and useful summary of railroad traffic and operating experience during the period of sharp growth of war traffic.

Mr. McDougall treats a subject of profound interest and great current significance. Although in Chapter 5 he points up his results in terms of the

immediate problems of wartime wage and price control, the study is based on an examination of railway wage, employment, traffic, and earnings data for the United States and Canada over the full period for which comparable statistics are available. Correlation technique is employed throughout and very high accuracy of prediction is obtained. The present pamphlet is a "popular summary" of a larger work begun in 1941 and scheduled for later publication. It presents the high points of the analysis and the conclusions which it seems to demonstrate. McDougall draws attention to the hypothesis that wage payments in the railroad industry are limited by operating revenues. From his correlation analysis he presents formulae showing the extent to which (1) a rise in the wage rate will reduce employment, revenues remaining constant; (2) a rise in revenues with wage rates constant will increase employment; (3) a rise in hourly wage rates or in operating revenues will increase average yearly earnings. He points up the conflict between the short-run interest of the older employees, protected by seniority, and the long-run interest of labor as a whole in the maintenance of employment as well as the differential effects of a high wage policy on the part of the best organized men upon others less strongly entrenched. This concise presentation is perhaps the first statistically to treat a problem that has long aroused sharp controversy. Findings are sharply stated; the high accuracy of prediction stressed; and the close conformity in behavior of United States, Canadian, and British (where available) data is emphasized. The treatment might well be rounded out by a consideration of the means employed by carriers to accomplish displacement of labor with rising wage rates—more rapid introduction of mechanical equipment, changes in service, etc.—and their effects upon the shipping and travelling public and in the end upon the volume of traffic available.

ERNEST W. WILLIAMS, JR.

War Production Board

Tea under International Regulation, by V. D. Wickizer. Stanford University: Food Research Institute. 1944. vi, 198 pp. $2.50.

Another "must" book for students of international food control has been written by Mr. Wickizer, with the support of the Food Research Institute and the Rockefeller Foundation. He has composed a symphony with many such arresting themes as: tea, a typical product of the Orient and of cheap labor; tea exports chiefly from black tea estates in India, Ceylon, and the Dutch East Indies; relatively stable rates of production and relatively stable demand by importing countries; domination of production, manufacture, transportation, and distribution by the British almost unique (United Kingdom absorbing half the world's tea exports and 70 per cent of British domestic distribution handled by four blender-distributors); two-thirds of importing market within the British Empire (United Kingdom annually consuming 9 pounds, United States 3/4 pound per capita).

Falling prices and mounting stocks induced producers' associations of India, Ceylon and the Dutch Indies to limit 1930 production—producers of cheaper teas reducing output more than growers of finer teas because the cheaper or "filler" teas enjoy a livelier demand in a rising market. The 1933 agreement prohibited new planting unless "the existence of a tea estate would otherwise be imperiled." The export of tea seed and slips was prohibited. By 1943 tea prices and estate shares showed recovery.

Under the first five years of tea regulation the greatest disappointment was the failure of tea consumption to expand as anticipated.

Control for another five years began April 1, 1938, and stipulated that, if production in any country greatly exceeded export quotas plus local consumption, that country should immediately restrict such excess production.

Mr. Wickizer attributes the comparative success of tea control to the restraint of the controllers in not unduly protecting the marginal producers and in aiming at stabilization rather than a valorization or elevation of prices. That restraint moderated the encouragement afforded competitive and unregulated producers to increase production, while giving relief from excessive fluctuations.

International food control under the plans of the United Nations is of rising importance and Great Britain promises to play, after the war, a leading role both in importing markets and in very important producing areas. British interests are likely to be protected or directed by the British government. Hence British tendencies and capacities are quite worthy of any reader's serious attention. They are well scrutinized in the little volume under review.

CAROL H. FOSTER

Washington, D. C.

Food Rationing and Supply, 1943–44. League of Nations Publication. New York: Columbia University Press; Economic, Financial and Transit Department of the League of Nations. II. A. 3. 101 pp. $1.00.

This report follows another in the same series, entitled *Wartime Rationing and Consumption* which gives a general description of rationing systems and information on goods other than food.

In three chapters we are given a comprehensive, round-the-world view of food rationing and food supply as it was toward the end of 1943. Most emphasis is naturally placed on the European situation. Information is least for Russia and Japan.

Chapter I is devoted to "Food Rationing and Consumption" and gives an excellent description of "legal rations." Chapter II, "Nutrition and Health" discusses measures of health and vitality. Chapter III is entitled "Production and Supply" and briefly surveys the world food supply situation and its changes during the war.

The limitations, statistical and otherwise, on the use of "legal ration" data

as an index of actual consumption are very properly indicated at the outset. In the United Kingdom and probably in Germany the full rations are available, but in the German occupied areas there is great diversity in the extent to which the rations are supplied. Another variable is the "black market" which in various degrees flourishes everywhere.

On the basis of the legal rations at the end of 1943, the Nations of Europe fell into four regional groupings. At the top were Germany, Denmark, Bulgaria, Rumania, and Hungary with rations supplying a theoretical caloric intake sufficiently high to meet accepted average requirements of 3,000 calories a day per adult male. This is up to prewar levels. The vitamin and mineral content of the rations was also good.

In the second group were Belgium, Netherlands, the Protectorate of Bohemia and Moravia, Finland, and Norway with rations representing between 2,500 and 2,800 calories per day—or below prewar. With some exceptions, the quality of the rations was as good as in Germany.

In the third group were the Baltic States, Slovakia, France, and Italy with from 1,500 to 2,400 calories per day, definitely too low for health and sustained work.

The fourth group included Poland, Greece, Yugoslavia, and occupied Russia in which rations in 1942 were at famine levels and although improved in 1943 were still extremely deficient.

In the United Kingdom and the neutral nations (except Spain) the food rations were generally more favorable than in Germany. The British appear actually to have raised their nutritional level despite significant shifts in food habits.

In the Americas and the British Dominions food rationing has been used mainly as a means of making price controls more effective.

In Chapter II attention is turned to vital and health statistics. Most of the available direct measures are negative. Changes in birth and death rates and infant mortality are rather small but some regionalization is apparent. The United Kingdom, Sweden, Switzerland, and Denmark have actually reduced the civilian death rates during the war. Germany has apparently fared less well than Netherlands and the Protectorate. But in Italy, France, and Belgium the situation is graver, and in Poland, Greece, Yugoslavia, and occupied Russia it has been very black indeed.

Some of the scattered and incomplete statistics as to the prevalence of disease give evidence of serious malnutrition. A rapid increase in tuberculosis in French and Belgian cities and a greater incidence of diphtheria and scarlatina in several areas are noted. Some of the other serious diseases have increased but not to epidemic proportions.

The third and last chapter on "Production and Supply" is a somewhat sketchy survey of the changes in world production through the war years. Some important aspects are largely passed over as, for example, the effect on the Allied food supply of the loss of the East Indies to the Japanese. The discussion of changes in production of food in the United States correctly points out the wartime emphasis on livestock but undervalues the signifi-

cance of the crop changes that have taken place. It is stated that acreage of cereals in the United States decreased from 1942 to 1943, when an increase actually took place. This slip seems to have occurred because the British apparently do not count corn as a cereal.

The first three years of the war saw an expansion in food production in allied territory and a contraction on the continent outside Russia. In 1943, however, the continental situation improved with higher crop production.

The over-all impression gained from the report is that both sides have been more successful in handling the food situation in this war than in World War I. There is no immediate prospect that food shortages will contribute much to the defeat of Germany. The real victims have been those in areas under German control whom the Germans found it difficult or inconvenient to supply with food.

Ronald L. Mighell

Bureau of Agricultural Economics

Costs of Dental Care for Adults under Specific Clinical Conditions, by Dorothy F. Beck. American College of Dentists. Lancaster: Lancaster Press, Inc. 1943. 306 pp.

This monograph represents perhaps the most thorough and enlightened exploration yet available of the general issues involved in the problem of assaying and meeting the dental service needs of adults.

Section One deals with historical and descriptive material concerning (a) recent trends in public dental care including various legislative proposals bearing on the problem, (b) previous studies on time and costs of initial and maintenance care, and (c) methods used in estimating costs and the difficulties involved in the development of such methods.

Section Two provides information on (a) the type of patients included in the sample, and (b) basic averages for total initial and annual maintenance time and costs.

Section Three is devoted to summary and general discussion in which is included a rather full statement of the implications of the findings for private practice as well as for the problem of extending dental care to the entire population.

At first glance, the reader of this monograph may be led to conclude that actuarial findings on time and costs involving a total of only 485 adults in New York City hardly justify a descriptive monograph covering more than 300 pages of text and tables. A careful reading of the publication, however, quickly dispells such a conclusion; for the sample of 485 adults is used to fullest advantage as an illustrative example in order to facilitate discussion and consideration in the most thorough manner, of all the basic concepts and difficulties involved in the analysis and interpretation of future findings which will deal with the need for dental service among adults. The main value of the monograph lies not in the statistical tables covering a small

sample of adults, but rather in the description and elaboration of methodologies which will be of considerable usefulness for other workers of the future, who will deal with larger and more representative samples of the whole population.

Henry Klein

U. S. Public Health Service

Criminal Careers in Retrospect, by Sheldon and Eleanor Glueck. New York: The Commonwealth Fund. 1943. xiv, 380 pp. $3.50.

The study pertains to the careers subsequent to discharge from the Massachusetts Reformatory, of 510 persons who completed their sentences in 1921 and 1922. Two previous reports have been made dealing with the findings after the elapsing of five and ten years, respectively. The present book is the third in the series and deals with the 15-year span since discharge. Out of the original number, 439 were alive at this anniversary and about 94 per cent of these have been traced.

The book is divided into three parts, the first of which brings the history of the individuals up to the 15-year point; the second deals with the comparison of successes and failures on various axes of treatment background and personal characteristics; the third deals with prediction possibilities.

The presentation is partly in terms of case histories and partly in statistical terms. The numerical material is extensive but is largely incorporated in the text rather than put in tabular form. This makes it hard to judge the comparisons critically especially since the classes compared are often overlapping and do not emerge clearly in the text. The use of classifications which are not mutually exclusive leads the authors themselves astray in their interpretations, for they call attention to the consistency of the direction of differences for various classifications, when the classes are not independent. For example, p. 127, the reformed and unreformed are compared as to the percentage falling in such classes as first delinquent under age 14, first left home under age 14, parents economically dependent, and so on. Consistency in such comparisons doesn't mean much until we know to what extent the comparisons are independent.

Nearly 100 pages of the book are concerned with prediction of behavior by means of prognosis tables in which the combined "failure score" of the individual on certain traits is the argument. The authors state that the tables are not recommended for use at the present time since they have not been validated. They point out that they could have been validated by dividing the cases at random into two groups, one of which could be used to work out prediction tables and the other to test the predictions. They did not do this, however, nor is it clear what their evidence is for stating (p. 219) that "the chances of the predictions being high would be good, especially in the larger series of a thousand cases used in *Juvenile Delinquents Grown Up*." Actually if their prediction tables do not hold up when they come to be

tested in another series, a large series would reveal their defects more definitely than a small one.

Of the three prediction tables, 18, 19, and 20, the last two contain a major difficulty due to the fact that they are not based on complete subclassifications. Table 18 shows for each group of "failure scores" the percentage who remain serious offenders, who become minor offenders, who reform entirely, and who have temporary lapses after reform. The table can be entered with a given score and the probability of a person falling into each of these four categories ascertained. Tables 19 and 20 attempt an age subclassification, but instead of making this complete so that a person of a given age and failure score could get a prognosis, they show for each failure score what percentage of those who became minor offenders were under age 27 and what percentage over 27 (Table 19) and what percentage of those who reformed entirely were under 27 and over 27 (Table 20). Thus in the latter table those who reform entirely are now 100 per cent, yet the authors refer to their age distribution as giving "the probable age at reformation" and also as giving the chances of reforming while under age 27 or at 27 or older. Actually it gives neither. That the authors are misled by these tables is shown repeatedly in their illustrative examples. Thus, p. 229, they use Table 18 to show that "Robert's chances of reformation were . . . three and one-half in ten" and in the same paragraph they use Table 20 to show that "Robert, with a failure score of 167.4 had only two chances in ten of reforming when under 27 years of age, but almost eight changes out of ten when 27 years or older."

The prediction tables are dubious, therefore, not only because they have not been validated but because they do not give prognosis figures specific for variables that are of importance in the problem.

MARGARET MERRELL

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How Nazi Germany Has Controlled Business, by L. Hamburger. Washington: The Brookings Institution. 1943. 101 pp. $1.00.

In recent years there has been a series of books which have attempted to determine the nature of the Nazi economy. So far as the basic interpretation of Nazism is concerned, these books fall into two general categories. One school of thought says that Nazism involves political totalitarism and extensive government regulation but still may be identified with capitalism. The other school of thought, whose most notable spokesmen are Stolper, Burnham and Lederer, denies the capitalist character of the Nazi economy. Although L. Hamburger in *How Nazi Germany Has Controlled Business* contributes no new information, he does provide a short well-written summary for the case that Nazi regulation of business has done a job equivalent to nationalization or outright government ownership. This amounts to saying that the Nazi economy is not capitalist and is an enticing view since it makes

the differences between National Socialism and democracy appear to be not only political and ideological but also economic. It sees the two as fundamentally different economic systems, as private capitalism and brown bolshevism.

The spokesmen for the other school of thought agree with Hamburger concerning the extensiveness of the controls but disagree with him concerning their significance. They maintain first that capitalism must be defined to include monopolies and government intervention and should not be described in terms of the model established by the classical economists. Secondly, they insist that the profit motive is still a generating force in the Nazi economy. They point out that in a monopolistic system it is difficult to maintain profits without the totalitarian political power which is the distinctive feature of National Socialism. If totalitarian political power had not abolished freedom of contract, the cartel system would have broken down. If the labor market, raw materials, prices, credit and exchange control offices were in the hands of forces hostile to monopolies, the system of monopoly profits would be threatened.

Nazism is thus the dictatorship of the National Socialist party, the Bureaucracy, the Army, and big business for complete organization of the nation for imperialist war. Preparation for totalitarian war requires huge expansion of the production-goods industry and makes it necessary to sacrifice conflicting economic interests. This, in turn, requires the incorporation of the total economy into the monopolistic structure. It means that the automatism of free capitalism, precarious even under a democratic monopolistic capitalism, no longer exists. But capitalism of a monopoly form still remains. National Socialism utilized the daring, the knowledge, the aggressiveness of the industrial leadership, while the industrial leadership utilized the anti-democracy, anti-liberalism and anti-unionism of the National Socialist party which had developed the techniques by which masses can be controlled and dominated.

MAXINE SWEEZY

Washington, D. C.

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JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION

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WARTIME DEVELOPMENTS IN AGRICULTURAL STATISTICS

BY H. R. TOLLEY AND CONRAD TAEUBER
Bureau of Agricultural Economics

WARTIME FOOD requirements were one of the major factors which led to the establishment of the Department of Agriculture in 1862 and to the beginning of its current crop reporting system. The first Commissioner of Agriculture was charged with the development of current reports on crops and their condition, and set out immediately to expand and strengthen the work in this field. One of his first acts was the employment of a statistician to assist in this task.[1]

Interest in crop production and crop conditions has been widespread from that time forward and the sytem of collecting and preparing reports has grown steadily. When World War I brought the establishment of a Food Administration and other agencies to handle the many new problems created by the war, the crop reporting service provided an existing organization that was able to supply a part of the needed information. But the needs far outran the available statistics, and many devices were developed to obtain and analyze reported data and present the information.

A realization that some of the problems which had been brought into focus by the war would not disappear with the ending of hostilities led to careful consideration of what ought to be continued. It was not enough to collect data; there was a great need for analysis and for application to the economic and social problems in agriculture. The establishment of the Bureau of Agricultural Economics was a step in the direction of capitalizing on the gains that had been made in techniques for solving problems that call for quick and accurate information and competent analysis.

The post-war agricultural depression brought forth many proposals for government aid to agriculture. Both proponents and opponents

[1] *A History of Agricultural Experimentation and Research in the United States, 1607–1925.* Alfred Charles True, Misc. Pub. 251, U. S. Department of Agriculture, June 1937, p. 45.

lacked current and reliable information; consequently there was much pressure to expand and modify existing series and to develop new ones. This offered an opportunity to apply modern statistical techniques, and many of the developments of that period became the foundations of current statistical series. Later, when the action programs of the 1930's were developed, the administrators found a large body of available data and some analysis which helped in outlining problems and problem areas, and served as a guide in the formulation of policies and programs. The new agencies became consumers of data other than those which were readily available and in turn became sources.

With this background of experience, the Department of Agriculture had accumulated a large body of statistics relating to the agriculture of the United States when World War II began. It had also a mechanism which could readily be adapted to meet many of the specialized needs of wartime food management. Therefore, it was unnecessary to develop an entirely new organization for that purpose. Nonetheless, some new series had to be started to fill new administrative needs; some old series had to be expanded; and wider coverage was required in some cases to provide detail, or because of administrative needs for information concerning every potential respondent. There was a rapidly growing demand for information on food distribution and food consumption, which had been developed far less fully than information on production. Much of the demand is still unmet. Some reports were needed more frequently than they had previously been available, and the demand was insistent for data for smaller areas, for a break-down of national figures by regions and states, of state figures by counties, and for areas within counties.

In many cases, refinement of concepts and procedures, greater geographic detail and greater precision would have been desirable. The administrators of the new programs appreciated the need for and the utility of adequate statistical information. The use of data in administrative decisions and action and the consequent demand for high standards of precision were not new, but wartime pressures brought them into sharper focus than had been the case earlier.

Prices.—The demand for information was particularly insistent in connection with the price programs. The parity legislation of the middle thirties had set up a general definition of parity prices and such prices had been calculated for the principal commodities, but the list of commodities was far from complete. Price-support and price-ceiling programs not only required parity prices for virtually all agricultural commodities, but called for much more detailed information than had

been needed for the peacetime programs. It became necessary to establish not only the general level of prices, but also specific price differentials for grade, location, and season. Such data were needed for both support-price and price-control purposes; this involved a considerable volume of additional information.

Government programs in turn affected prices and differentials, and made it even more important that the data correctly reflect the current price movements. At the same time, they increased the problems of data collection, for in the absence of normal relationships there was greater need for measurement of relatively small changes as well as assurance that the reported changes reflected actual changes and not primarily fluctuations resulting from sampling. The collection of price data for programs of administered prices has had to cope with additional problems in order that the reported prices might reflect accurately the movement of prices actually received by sellers. For some commodities there were large-scale dislocations of markets, which sometimes resulted in prices that varied considerably from those prevailing in the established markets. Some commodities that may pass directly from producer to consumer without going through other market channels were particularly subject to the operation of black markets. The influence of such transactions on the price level cannot be disregarded, but having them properly reported is difficult.

Prices farmers pay is the divisor used to determine whether the index of prices received is approaching or departing from the levels that assure parity. The problems encountered in estimating prices farmers pay have been similar to those met in constructing the cost-of-living index of the Bureau of Labor Statistics: The disappearance of certain items which formerly were purchased in large numbers, and the shifting importance of certain items as shortages developed, black-market operations, tie-in sales, hidden price increases, a substitution of higher-priced packaged goods for lower-priced bulk goods formerly purchased, population shifts, etc.

Attention has recently been called to the fact that the index of prices paid by farmers for consumption goods rose by 45 per cent from December 1940 to March 1944, whereas the cost-of-living index of the Bureau of Labor Statistics increased only 23 per cent during the same time. A careful analysis of the items covered by the two indexes—the effect of differences in population weighting to allow for the fact that half the rural population lives in the South; the effect of including rent and services in the one index, and their absence from the other; as well as of other differences in basic concepts—has shown that the movement

of the two indexes has been remarkably close for those items that are comparable.

Farm income.—Farm income statistics, both gross and net, are estimated by years beginning with 1910; net farm incomes have been estimated annually by states since 1940. But there is need for more detailed information concerning farmers' incomes, their receipts, and operating expenses. These are needed by type of farm as a basis for ceiling and support prices. The lack of comprehensive data relating to distribution of incomes by size has been a serious handicap in the analysis of the effects of a number of programs. The extent to which farm families are dependent entirely on their farm incomes or typically supplement them by income from nonfarm employment has been a controversial question in much of the discussion of agricultural policy. The data to settle this question are not now available, but there is some prospect that they may be obtained in the near future.

Agricultural production.—The need for production statistics for wartime agricultural programs has been met largely through the series that had been developed earlier. Some reductions were made during the defense period, when all activities were under scrutiny to find what might be eliminated "for the duration." It soon became apparent that this was not the field in which to cut, for data that had been useful in peacetime became vital in wartime. Although the frequency and detail of some publications were somewhat reduced, and some were eliminated entirely, in general there was an increased demand for production data. Time and again the existing machinery for collection of data and the basic data that had been collected in the past were pressed into service to supply some emergency need. The farmers who, as volunteer crop reporters, provide the basic link in the machinery for collecting production data, were quick to sense that facts are weapons of war, and were willing to do their share, even though it meant special questionnaires or additions to questionnaires already long.

A major gap in the current production statistics is that relating to the production of vegetables in home gardens and in commercial market gardens from which about all of the product is moved by truck to nearby cities. The increase in the number of home gardens made it especially desirable to obtain information about that segment of production for which it had not been possible previously to develop satisfactory statistics. The highly specialized field of vegetable production has always been one of major difficulty, for sampling there is unusually difficult. A number of agencies attempted surveys of production in home gardens and home canning, but on the whole these were not suc-

cessful. A sample enumeration in the fall of 1944 is expected to provide more adequate statistics than those hitherto available and, it is hoped, will make it unnecessary to continue the use of some of the crude estimates which have served in lieu of facts in this field.

Distribution.—Although agriculture in the United States has broken all previous production records during the last eight seasons, there has not been enough food to provide all possible claimants with all they were ready to buy. The management of food supplies to assure equitable distribution to and among the claimants, whether Armed Forces or civilians, and whether domestic or foreign, has shown the need for new statistics on distribution. It was necessary to expand the data on position of stocks of a variety of commodities and to develop data for other commodities. Data showing the movement of commodities through trade channels became essential, if critical supplies were to be used adequately. Such information obviously was needed for the vast supplies which were purchased by Federal agencies, but in many cases information concerning those supplies which were moving through private trade channels was also needed. The collection of data by the Office of Price Administration built up a new body of information on movement through wholesale and retail channels.

The administration of price-control programs calls for elaborate data showing prices of farm products and their derivatives at all levels of the marketing process. The existing series on the proportion of the food dollar which goes to the farmer provided far less detail than was needed. A large body of information has been collected, including comprehensive audits of firms representative of a number of branches of the food trades. These data were collected to meet immediate administrative needs; but, together with other information becoming available, they can serve to open up new areas for analysis.

The need for sharpening concepts and definitions which arose out of the administrative use of data is illustrated in the statistics that show the proportion of the consumer's income spent for food. A variety of measures for different purposes are available: (1) the proportion of total income actually spent for food, (2) the proportion of comsumption expenditures which went for food, and (3) the proportion of income or expenditures required to purchase a "market basket" of relatively fixed content. The first of these measures has gone up rapidly, reflecting increases in food prices, increases in the quality and quantity of food purchased, increases in the number of meals eaten out, increased expenditures for liquor, and other changes in food-buying habits. The second reflects all these elements, plus the effect of the unavailability of some

consumer's goods. The third reflects the changes which are due solely to changes in prices of foods, and does not reflect changes in consumption and buying habits. Each of the three serves a useful purpose. Drawing them into the forum of policy debate and action revealed a need for reexamination and some revisions. Although the changes which actually resulted were minor, more confidence can be placed in the figures which resulted from the process.

Processing.—Food processing had not been of major concern in the activities of the Department of Agriculture before the war, and relatively few statistical series had been developed in this field. Data relating to manufactured dairy products were one of the few exceptions—the Department, in cooperation with state agencies, had developed a comprehensive series of information on this subject. As control and subsidy programs were developed it became apparent that the existing system could be used as a nucleus for collecting the expanded data which were required. The needs of the Office of Price Administration, War Food Administration, Defense Supplies Corporation and the Bureau of Agricultural Economics are being served through a consolidated reporting procedure under which the reports required by these agencies are shipped to one office, where they are jointly processed. The saving to respondents as well as to the government is obvious.

In some other situations such an expansion of existing organization and procedures was not possible. The War Food Administration needed a variety of information about fields that were largely unknown. In a few instances so little current information was available that the office charged with the administration of an order was unable to make an accurate advance estimate of the number of firms involved, or of the proportion of the product which came from the several parts of the industry. Current reports were developed to reflect current operations, and, in many instances, reports for a designated base period were collected in order to provide a basis for administration of an order within the framework of existing relationships in the industry. In conformity with policies laid down by the Bureau of the Budget, reporting by the smaller firms, which account for only a fraction of the industry's output, has generally been curtailed, either as to content or frequency or both.

There is little doubt that some of the new series which have been developed in response to wartime needs will continue to be needed in the administration of peacetime programs. Statistics of livestock slaughter are a case in point. Before the war, much of the current data on this subject were byproducts of the reports by the Federal Livestock

Inspection Service. Wartime meat controls have expanded the number of plants under Federal Inspection, and have also called for reports from other segments of industry. As a result there has been developed a more complete statistical picture of that industry than had been available before. This volume of information should serve as a basis for developing a more adequate system of current reporting than has been available heretofore, and provide a basis for sampling which would not have been possible otherwise. Moreover, the data collected from the smaller commercial slaughterers and from certain farm slaughterers provided information relating to one segment of the industry about which little had been known previously.

Food consumption.—Data relating to food consumption became one of the major needs, and the lack of adequate information in this field was one of the major gaps in the data which were available. The distribution of food among all population groups under rationing, a comparison of foods actually consumed with nutritional requirements, and a comparison of food consumption in the United States and in the countries receiving food through Lend Lease posed problems for which no easy solution was available. The use of figures showing the disappearance of foodstuffs in total or per capita soon proved inadequate to the needs of the situation. Such totals or averages fail to reveal how the food is distributed within a population and whether certain groups are far above or below the average. In Great Britain a periodic survey of actual food consumption among the several population groups was carried on as an essential part of the food-management problem. No similar information about food consumption was collected directly from a sample of families in this country. One small sample investigation was made as part of the Study of Spending and Saving in Wartime. Because such data would have provided valuable assistance in food management, a number of other surveys of consumption, and of savings and expenditures were planned, but the necessary approval and funds were not forthcoming. The need for more current information about food consumption as such remains largely unfilled. There is also an urgent need for better units of comparison of nutritive levels. They are needed for comparisons of geographic and other groupings in this country and for comparisons among countries. A recent study compares the situation in Great Britain, Canada and the United States and clearly illustrates the needs and the shortcomings in present data.[3]

In large measure the problem of developing food statistics as such is

[3] *Food Consumption Levels in the United States, Canada, and the United Kingdom.* Report of a special Joint Committee set up by the Combined Food Boards, U. S. Department of Agriculture and War Food Administration, April 1944. 121 pp.

the problem of shifting the emphasis from agricultural production as such to agricultural production in relation to food needs. The volume of agricultural production and the volume of available food supplies are not necessarily identical, nor does an adequate total supply of food assure adequate supplies to all economic and social groups in the population. But the realization that this is so is largely a development of recent years. The units and techniques for current measures of food consumption in part remain to be developed.

Feed.—The development of programs for increased production of livestock and livestock products called for more complete data on feed and feed supplies than had previously been available. For example, there was need for more complete information as to production, distribution, and utilization of oilseed meal and other manufactured feed. Data showing utilization of feed supplies by different types of livestock are needed to improve estimates of the livestock-feed balance and to enable more adequate planning for utilization of supplies. As the distribution of feed became a major activity of the War Food Administration, data showing interstate movements of farm-grown and manufactured feeds became particularly important. Steps were taken to obtain such information for most of the manufactured and byproduct feeds for the year 1942, and data relating to the interstate movements of oilseed meal are being collected currently as a part of the administration of the set-aside programs for such meal. There has also been some expansion in the information being collected about some other feeds, such as tankage and meat scraps, fish meal, byproduct feeds, etc.

Farm labor and farm population.—It became apparent early in the National Defense Period that surpluses of farm labor which had been general throughout much of the preceding decade might disappear very rapidly and that stringencies in the farm labor situation were likely to develop. The farm labor statistics collected then were not adequate to meet anticipated needs, and, therefore, plans for expansion and improvement of these statistics were prepared. But, except for a short-term expansion, the necessary authorization and funds did not become available. Some improvements, particularly in the wage-rate data, however, have been made, including the collection of wage rates for specific operations, such as cotton picking, orange picking, blocking and thinning beets, etc. The growth of the monthly enumerative sample counts of employment and unemployment by the Census has provided some additional information on agricultural employment, and has served in turn to raise questions of definition and coverage. The Census series is based on individual reports; the Bureau of Agricultural

Economics series is based on establishment reporting; and differences between these two methods of reporting called for careful investigation.

The effect of other differences also required analysis:

(1) A person who works part-time in agriculture, while devoting the major portion of his time to a nonagricultural activity is reported as a nonagricultural worker in the Census series, but if he works more than the specified minimum time at agriculture, his contribution is counted in the Bureau of Agricultural Economics series;

(2) The Bureau of Agricultural Economics series specifies a minimum of two days' work in the sample week and the Census has no such minimum requirement;

(3) The difficulty of objectively defining the concept of unpaid family workers and consequently of enumerating such workers.

In cooperation with the Bureau of the Census a survey was undertaken in April 1944, embodying an attempt to clarify some of these problems, and including an experimental approach to an objective classification of unpaid family workers. Although the results have not yet been completely analyzed, they indicate the way to better data.

Drawing large numbers of unusual workers into the agricultural labor force has introduced some new problems in the reporting of farm labor, but at the same time it has created a need for more adequate information on this development. One survey, undertaken in cooperation with the Bureau of the Census, provided information showing the total number of persons who worked in agriculture during the year, and their time inputs. It found that in 1943, when agricultural employment varied from a low of 8.2 million in January to a high of 11.9 million in October, a total of 14.5 million different persons worked some time in agriculture. Such information provides a much more adequate guide to the size of the recruiting problem than does the net difference between the seasonal high and the seasonal low, which were the best data previously available.

Estimates of changes in the farm labor supply have been in constant demand, but they have proved much more difficult than have estimates of the number of persons actually working in agriculture. Because the bulk of farm workers at any one time are farm residents, these demands called for development of farm population figures. Early returns from the 1940 Census had indicated that the concept of farm population—defined as all persons living on farms—was no longer the useful analytical tool it had been when it was first given Census recognition a quarter of a century ago. A large number of persons living on farms are not engaged in agriculture, and, conversely, a large number of persons en-

gaged primarily in agriculture do not live on farms. Defining a farm so that enumerators could readily recognize an establishment as being or not being a farm had become more difficult as a result of the growth of part-time farming, suburban living on relatively large tracts of land, the development of transportation and other equipment which reduced the need for the operator's living on the farm, and the growing number of persons using farms as places of residence, whether or not they were directly associated with the agricultural enterprise. Differences in coverage of the Censuses of Population and Agriculture were carried forward in current estimates, which necessarily took the basic Census figures as the point of departure. Analyses in progress have not yet provided a conclusive guide to future practices and definitions, but are resulting in clarification of concepts and in more usable data.

Public opinions and attitudes.—A major expansion into a new subject matter field for the Bureau of Agricultural Economics was the development of the work in public opinions and attitudes. This work started on a small scale in the Agricultural Adjustment Agency in 1936, when the administrators of that Agency felt the need for greater knowledge of the public attitudes toward their program and the way in which it was operated. The service proved so useful that in 1939 more systematic development was decided upon and thus an organization was ready to meet the wartime needs of administrative agencies for such data. Program administrators needed to know quickly how a program was being received by the people most affected and by the public at large. They needed to know also the reasons for success or failure, and to get suggestions for possible improvements which might be used in that or in similar programs to be developed later. The interpretation which people placed on the provisions of a program and its restrictive or benefit features, and the ostensible or real reasons for the actions they took were of vital concern to administrators of fast-moving programs. Many of the wartime activities were along new lines and past experience provided little guidance. To carry them out successfully required a quick and reliable means of telling administrators how people reacted to these wartime activities and programs. Attitude and opinion surveys provided one of the means of obtaining such information, and they were increasingly in demand. They were used to interpret reports on Farmers' Intentions to Plant, and obtain information as to views of farmers on price-support programs, on the corn-purchase programs, on proposals for marketing livestock at lighter weights, on rising land values and on other subjects.

Other surveys included responses to the "Clean Plate Club" cam-

paign, other nutritional campaigns, the potato storage campaign in 1943, the response of housewives to dehydrated foods, and others. The studies of attitudes and opinions were undertaken primarily for administrative use. When the results can be made available for wider use, they should provide valuable sources for studies of changing attitudes toward farm problems and for rural-urban differences in information about and attitudes toward farm problems and programs.

COOPERATION WITH OTHER AGENCIES

Since the beginning of the war there has been a noticeable increase both within and without the Department in the recognition of the close relationship of agriculture to other parts of the national economy. A number of the control programs were carried out through close working relationships with other agencies, especially the War Production Board, the Office of Price Administration, the War Manpower Commission, etc. This in turn has had its effect in the statistical work done in the Department, for there were frequent instances in which it was more necessary than before that the data for agriculture and for other parts of the economy be directly comparable; for example, problems of labor supply and demand, of wage rates, and workers' incomes. Statistics on dairy production were developed as a joint effort by the Bureau of Agricultural Economics, the War Food Administration, the Office of Price Administration, and the Defense Supplies Corporation. Statistics on lumber and forest products were developed as a joint undertaking by the Forest Service, the War Production Board, and the Bureau of the Census. Statistics on fats and oils became a joint undertaking by the War Food Administration and the Bureau of the Census with close relationships with the War Production Board. Statistics on stocks of soy beans, wheat, and other grains collected by the Bureau of the Census, the Bureau of Agricultural Economics, and the War Food Administration are now more effectively combined into reports on total stocks. Data on food costs and other living costs are of concern to the Bureau of Agricultural Economics, the Bureau of Human Nutrition and Home Economics, and the Bureau of Labor Statistics and there has been an increase in joint study of the problems encountered in collection and analysis of such data and of the comparability of the resulting series. Close cooperation was developed between the Bureau of Agricultural Economics and the Bureau of the Census to work out problems of estimating farm population and changes in the farm population. The new needs of the War Manpower Commission, the Bureau of Labor Statistics, and other agencies for data on farm population and

farm employment called for some reorientation in the previously available series.

A significant development in closer cooperation with agencies outside the Department of Agriculture was the establishment of a joint Agriculture-Census Committee for the planning of the 1945 Census of Agriculture. Carrying forward a long-standing tradition of cooperative planning of censuses of agriculture, the new arrangement provided for a committee with representatives of both agencies which had responsibility for developing plans for schedules and tabulation. As a result of the efforts of this committee, it is believed that the forthcoming Census of Agriculture will provide data more useful to agriculture than those that were previously available. It is also anticipated that the quality of the enumeration will be improved as a result of the cooperation between Census enumerators and representatives of agricultural agencies in the field.

SAMPLING TECHNIQUES

The need for quick surveys providing reliable information for a representative cross section of the entire United States, regions, states or other areas focussed attention on sampling procedures and field enumerations. Moreover, it has been increasingly apparent that the conduct of numerous field surveys, each using its own sampling procedures, made for lack of comparability of results, and, consequently, for inefficiency in the conduct of such surveys. Therefore, work was undertaken to develop some uniform and integrated sampling scheme for surveys in rural areas. It was decided to develop a sample of farms which in effect would be a small replica of all farms in the United States. This sample is designated the "Master Sample." It consists of a sample of small geographic areas including a total of approximately 300,000 farms. It is subdivided into three independent national samples, each comtaining approximately 100,000 farms, which can be used separately or combined. Subsampling is also provided for. Moreover, the work has been done in such a way that additional samples can readily be drawn as needed. Farms in every county in the country which contain agricultural enterprises are included in the sample.

In each county, the entire area was divided into small areas consisting of clusters of about 5 farms each. These small areas are defined in such a way as to be bounded by political boundaries, by roads or other physical characteristics insofar as possible, because it is essential to the scheme that boundaries be readily identified by the enumerators in the field. Aerial photographs for most of the sample areas

are available and are proving of assistance in locating boundaries where they are not readily identifiable in the field from maps. Within each county, three samples, each consisting of approximately one-fifty-fourth of the small areas as defined, were drawn in such a way as to represent all parts of the county. With the boundaries of the sample areas established, a set of rules has been developed for the purpose of associating each farm with one and only one sample area.

The work of drawing the sample has been done cooperatively by the Bureau of Agricultural Economics and the Bureau of the Census, using the facilities of the Statistical Laboratory maintained by the Department of Agriculture and the Iowa State College. As part of the forthcoming Census of Agriculture, a supplemental set of questions is to be taken from each of the farms in the Master Sample areas. This will provide for more information than could be obtained if it were necessary to ask all questions of all respondents. Present Census plans also call for some preliminary tabulations from the main schedule with the use of this sample for early release. Satisfactory state estimates can be prepared for most items through the use of this sample.

As each farm enumerated by the Census will be associated with the appropriate sample area, tabulations can be made which will provide information as to the items covered by the Census for the sample areas as such, or for any specified combination of the sample areas. This should provide more adequate background information for subsequent surveys and will also provide a basis for more efficient subsampling to meet the special objectives of particular field surveys.

This area approach to sampling is useful for other than agricultural purposes. A sample designed primarily for population and related enumerations is now being drawn for incorporated places and for "thickly settled" unincorporated areas where nonfarm and farm populations are intermingled. This, like the work for farming areas, is being done cooperatively by the Bureau of Agricultural Economics, the Bureau of the Census, and Iowa State College.

The Master Sample has already demonstrated its utility in small-scale field enumerations, both National and state-wide. Its major usefulness will be in its applicability to field surveys. Because it provides an efficient sampling tool, it is expected to stimulate better sampling in field surveys. But the use of the Master Sample is not limited to its use in field enumerations. Experiments have been carried on to test the possibility of combining the use of the Master Sample with mailed inquiries. Because the characteristics of the population in the sample areas can be known, it is possible to correct for a large part of the bias

which frequently develops in mailed inquiries. A comparison of the characteristics of the persons who responded to the mailed inquiry, with a similar tabulation of the characteristics of all respondents to whom the inquiry was sent, provides a means of knowing whether the returns actually received are representative of the entire universe or only of that portion which supplied information. In this way the use of the Master Sample promises not only to improve field enumerations but also to improve the results from mailed inquiries.

Another possibility lies in the combination of mailed inquiries and field enumeration, using the field enumeration to fill in the gaps which the mailed inquiry leaves. A similar technique has been used with good results in a survey of sawmills. There, the sample was selected from a pre-listing of all sawmills. The mailed questionnaire was used in order to reduce the cost of the collection of data, and a sample of the firms that did not report by mail and those sending inadequate reports were subsequently visited by a field enumerator.

However, the major advantage of this sampling device lies in its use in connection with field enumerations. Sampling designs can be prepared more effectively and a number of designs can be used which would be impossible without the Master Sample. If for any reason field work for a survey is not entirely completed, the portion which is obtained can be evaluated more readily than would be the case if the characteristics of the total sample were not known. The information obtained by each new survey adds to the knowledge of the farms in the Master Sample. As the sample land areas are clearly defined, changes in number of farms, ownership, size of farm and farming conditions, changes in farm population, and similar changes can be estimated independently of other data. Consequently, the Master Sample will not become out of date, but will reflect changing conditions in agriculture.

The development of the Master Sample opens a new field in the collection of agricultural data, but also opens a large new field of research in sampling problems. Because it provides a great increase in sampling efficiency over current methods, it will provide the same information with smaller samples than are now feasible, or greater precision for a sample of given size. Further improvements in sample design and improvements in techniques for subsampling are to be expected as this tool for research is developed and as it is used in the field.

Many inquiries are necessarily limited to a sample much smaller than the total number of farms in the Master Sample because of limitations of funds and personnel or because of the nature of the problems with which they deal. In many instances these smaller samples are best de-

veloped by selecting a sample of counties and enumerating all farms in the Master Sample Areas within them. A number of techniques for selection of sample counties are being used and studied. In one recent instance, the techniques of component analysis have been applied to this problem with what promises to be highly useful results. The problem, in one case, was to design a sample of approximately 70 counties which would represent the major type of farming areas. It was desired to salvage as much as possible of a smaller sample which had been selected earlier for related work, and to provide maximum freedom of choice for the field workers who were in close contact with representatives of the state colleges of agriculture. Through the use of component analysis a scheme for stratification was devised, which provided for control of the major relevant factors and also met the practical considerations of the situation. The field workers were given freedom to choose within the sub-strata; the results of their selection were then tested for bias; and subsequent adjustments in the county selection were made as required. The full possibilities of this technique for selecting sample areas for many types of inquiry remain to be explored, but the experience to date warrants considerable optimism for its continued utility.

THE OUTLOOK

Food and agriculture are likely to continue to be subjects of Government programs and public concern. Therefore, demand for statistics as guides for action will continue as a basis for checking on action already taken, and as a basis for understanding past, current, and prospective developments. A major reconversion problem for agricultural statistics lies in finding ways and means of utilizing the gains that have been made in (1) the development of more adequate statistics in some fields, (2) providing more substantial bases for many of the estimates which were made under wartime pressure, on subjects for which information will continue to be needed, and (3) the development of statistics in essentially new fields. When War Food Orders and similar controls calling for reports from every person affected, are relaxed, the need for information in many instances can be fulfilled through returns from a sample of the respondents. Current compulsory reports with nearly complete coverage also provide a basis for selecting more efficient samples than has been possible heretofore. Developing information on food processing and the movement of food through the several channels from producer to consumer may be easier in the future because there is a growing awareness of the utility of central collection of statistics.

Although early in the war there was considerable opposition to the numerous questionnaires called for by government agencies, many business establishments have recognized the utility of the data being collected. Through the efforts of the Bureau of the Budget, in cooperation with agencies originating inquiries to the public, much of the unfavorable reaction has given way to an understanding of the needs for and the ways of using the data collected. At present the Bureau of Agricultural Economics is unable to meet all of the requests for information and for the establishment of statistical series which originate with business interests.

Wartime developments in agricultural statistics involved gains as well as losses. Existing techniques for the collection of data have been further developed to meet wartime needs and, in some instances, new techniques have been devised. The growth of the use of sample enumerations, utilizing small samples to obtain unbiased results at relatively little expense is a development which undoubtedly will continue to be of major importance. It is probable that in the collection of agricultural data in the future less reliance will be placed on mailed questionnaires and more on sample field enumerations, and that ways will be developed for increasing the efficiency of each of these techniques. Only a small beginning has been made in the exploration of possibilities of combining the advantages of these two techniques.

There is a growing need to investigate the techniques for collection of data. Little is known about the interaction between interviewer and respondent and the conditions which make for accurate or inaccurate responses. Some investigations in connection with public opinion and attitude surveys have revealed the possibilities of direct or indirect influence of the interviewer on the response, but this field needs further exploration. It is known that in the collection of quantitative data, certain biases are likely to enter. For example, income or value of product is frequently understated. The assumption that an interviewer who is familiar with the subject matter assures adequate responses from most respondents needs further testing, and much more research is needed on the process by which information can be most effectively obtained.

Selecting individual respondents is one aspect of sampling as practiced in connection with agricultural surveys which needs more attention. The Master Sample provides one means for eliminating much of the bias present in most current methods used in selecting the individual respondent. Other devices can no doubt be developed to fit the various field situations which arise.

There is need also for developing ways of reducing the volume of in-

formation which must come from any one respondent if the necessary information is to be obtained with the required degree of accuracy. Recent developments in sampling suggest that there are ways in which samples of respondents can be matched for the relevant control characteristics and parts of the total volume of information secured from each in such a way that over-all figures can be developed from these samples. There is need also for the development of techniques for use in sampling within the volume of data ordinarily considered necessary in surveys involving consumption, expenditures, and other fields of behavior.

Until relatively recently, developments in techniques for analysis of statistical data have outrun techniques for collection of such data. This is a gap which should be and is being closed. The application of some of the work in design of experiments for biological research to that in economic and social research has opened up new techniques for data collection. During and shortly after World War I, the demand for all kinds of data grew rapidly. In many cases information was collected without much thought of its ultimate use. Some of the collection of data done recently under the pressure of wartime needs has been disappointing to the responsible administrative agencies, chiefly because the techniques used in collection were not such as to permit adequate utilization of the data once they were assembled. There is a need for continued development of a critical approach to the collection of data as a useful tool and for parallel recognition that in unskilled hands this tool is inefficient and possibly dangerous, and that very frequently the results may be misleading.

As more adequate national data are developed, demand for the development of similar materials for smaller areas is persistent. Many of the data that are now being collected are needed for relatively small and homogeneous production areas. State and county estimates are in constant demand, but at present this demand can be met only in part. Periodic sample enumerations would go far in meeting such demands. They would also relieve the pressure on the quinquennial and decennial censuses of agriculture, which are now the major source of data for small areas. It may well be that other techniques can be developed to meet these local needs which arise largely out of demands for action.

INSURANCE IN THE INTERNATIONAL BALANCES OF PAYMENTS

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I

It is the basic principle of insurance to spread risks in space and time as widely as possible in order to bring into play the law of averages. The distribution and compensation of risks beyond the political boundaries of the home country is thus inherent in the very nature of insurance. There is marked distinction between the urge to export goods and the need for international insurance cooperation. In case of insurance, though the companies are of course looking for profits, it is not primarily a question of increasing the turnover, it is first and foremost a technical necessity, the fundamental need to broaden the basis of risks in order to produce stability and equilibrium in the business.

The spreading of risks beyond the political frontiers of the home country can in principle be achieved by three means: (i) direct insurance operations in foreign countries, (ii) affiliation of foreign insurance companies, and (iii) reinsurance. And indeed before World War I international insurance business kept pace with the development of international trade and commerce and became an important factor in world economy. Along the highways of international commerce the insurance companies of the great trade nations established branch offices and agencies or founded affiliated national companies, thus spreading and popularizing insurance over the whole world. The tremendous growth during the fifty years before the Great War is due largely to the international activities of the pioneer insurance companies.

This development reached its peak with the Great War, which abruptly interrupted and in many cases reversed international business relations. It is not necessary to review here all those measures of economic warfare which were adopted a quarter of a century ago and which, unfortunately, have had to be re-introduced now—they are generally known. As a result of those measures and subsequent political and economic events, the writing of direct insurance business on an international scale is showing a relative or absolute shrinkage. Countries which not long ago were without national insurance organization have already built up or are building their own insurance markets, in others the growth of the home companies was speedier than that of the foreign companies and the relative position of the two groups had already changed to the disadvantage of the latter. This process of na-

tionalization of direct insurance business was given impetus after the Great War by legal, administrative and economic measures of the Governments, by exchange regulations and other restrictions of international payments, by the transformation of branch offices of foreign companies into domestic enterprises, and so on. Conditions of the present war are carrying the process still further.

To what extent international direct writing insurance business declined between the two wars is illustrated by some figures. In Switzerland the share of the foreign companies in the total home business was 35 per cent, now it is less than 1.5 per cent. In Norway foreign business was 20 per cent and was reduced to 4 per cent before the present war. In Italy 40 per cent of the home business was in the hands of foreign companies which went down to 4.5 per cent between the two wars. In Finland the foreign companies held 12.7 per cent of the life business and 13 per cent of the fire business. Before the outbreak of the present war 100 per cent of the life business and 97 per cent of the fire business was in the hands of home companies. And even in Germany the share of the foreign companies in the home business in the period between the two wars has been reduced from 8 to 3 per cent. These are taken at random where appropriate statistics are available. More striking changes took place in more remote countries lacking statistics.

Reinsurance as a secondary form of international coöperation in insurance has grown very much in recent decades and has greatly increased in importance. In line with direct insurance it expanded in all directions. New systems and methods were devised, more suitable for world-wide activities. Though reinsurance, being practically invisible to the public, does not openly offend the nationalistic sympathies of some communities, it nevertheless could not escape thorough investigations everywhere of its effect on the Balance of Payments. Unfortunately those investigations, both in case of direct insurance business and reinsurance, were mostly based on incomplete statistics and misrepresented figures and, therefore, a brief survey of the methods of investigation and the interpretation of the results of how insurance affects the Balances of Payments may be of general interest.

II

An international Balance of Payments is interpreted here as a statement of all claims and debts arisen in a certain period of time between a given country and the rest of the world. A credit balance indicates a claim, a debit balance, a fresh indebtedness against foreign countries, arising in the period under review. This definition of the Balance of

Payments is not the only possible one. And indeed very important circles interpret it as an itemized account of the payments arising out of the commercial and financial transactions, conducted within a stated period, by the people of one with all the people of other countries.

It is obvious that the two definitions refer to two entirely different accounts. The first refers to an account of international indebtedness, the second to actual payments which have arisen in a certain period of time. In the first the decisive point is whether a fresh indebtedness arose during the period under review, irrespective of whether, in fact, the debt has been transferred to the creditor countries or not. In the second the decisive point is whether actual transfers have been made during the period under review, irrespective of whether the payments relate to new or old debts. The term "Balance of Payments" is used in both senses and it is always important to differentiate.

According to the established practice the Balance of Payments is divided into two main sections: (i) current items, i.e. goods, services and gold, and (ii) capital items. The distinctions have been said to be based upon the length of time they remain in existence. Current items are likely to be fairly constant in trend from year to year, since they reflect the consuming habits and producing capacities of a nation, whereas capital items are likely to fluctuate widely according to business and political conditions and prospects both home and abroad. As a rule, insurance is regarded as "service," as a part of the large and important class of "invisible" exports and imports. There are, however, exceptions to that rule. Canada, for example, finds that "the most desirable place for inclusion of the insurance item in a Balance of Payments statement seems to be among the capital items. The transactions are more akin to capital transactions than to service transactions, as they are normally executed only when a transfer is considered desirable and are not on the same basis as regular income payments. That is they are inclined to be unpredictable and are not, in any sense, analogous to a current income which varies closely with the general condition of trade." Such a view is a logical sequence of the conception of the Balance of Payments as a statement of transfers, but from the point of view of an account of international indebtedness, insurance transactions are certainly trade transactions, though they may be distinctly different from other "services." They are commercial operations *sui generis*. On the other hand, they are certainly linked with some capital transactions, particularly in case of life insurance. Theoretically the capital transactions should be segregated from the insurance transactions proper, the former belonging in the capital section, the latter in the trade section of the Balance of Payments. In the League of

Nations' standard form of the Balance of Payments, insurance is included in the current items and mixed up with commissions and brokerages. In some countries, however, insurance items in their national balances are divided from other transactions, and definite figures are given relating to insurance itself. How those figures are arrived at and how far they are reliable, is of course an open question in each case.

III

The estimation of the so-called invisible exports and imports, including insurance transactions, is admittedly an extraordinarily difficult task. In spite of all sincere efforts to develop reliable general principles upon which such estimates could safely be based, the produced figures remain as a rule more or less questionable approximations. The inquiry into the figures of the insurance business is, however, even more difficult, owing to the particularly complex nature of these transactions.

The mechanical comparison of the premium incomes and payment for losses of foreign companies in a given country on the one hand, and the similar items of the home companies in their business abroad on the other hand, is a method completely unsuitable to give even a vague idea of the problem. As far as the figures are reliable, such a statement would certainly give an idea of the volume of the transactions, but though it may be of some significance it would in no way indicate the profitableness of the business and its influence on the international Balance of Payments of the country. Other items which have to be considered are: interest, expenses, commissions, taxes, depreciations, profits and losses on investments, increase or decrease of the so-called technical reserves (life fund, unearned premiums, unpaid claims, bonus reserve) and any reinsurance taken in the country of origin. In direct writing business through the medium of licensed agencies all these receipts and payments remain in the country of origin. Not before all these items have been properly considered and carefully computed, can a profit or loss of the year's transactions be ascertained, and only such a profit or loss figure could indicate whether a fresh debt had arisen and if so, to what extent and in which direction.

Government insurance statistics are, as a rule, entirely unsuitable for such a computation and statistics of different countries are even less suitable to compare results internationally. It sounds strange, and yet it is true, that insurance business, itself based on statistical experiences, in many countries lacks statistics about the state and development of its own trade. Either no statistics at all are available or else they are very defective. In any case the variations of statistical methods used in different countries recording some facts on insurance make

futile any attempt at international comparison of the results. In some countries the statistics are based on gross figures, in others on net figures. In some the whole business is accounted in total, in others it is divided into sections and branches. In some home and foreign operations, direct and indirect transactions are segregated, in others they are combined. In some countries the presentation of the published accounts is uniform, in others each company chooses the form of presentation itself, with the result that sometimes it is impossible even to gather the most elementary data on a uniform basis.

International direct insurance business through established branch offices or licensed agencies is one, but not the sole, factor in the investigation of international insurance transactions and their effect on the Balance of Payments. The second factor is international reinsurance transactions. In this international trade, too, everything from our point of view depends on the ultimate balance of the accounts. The volume of the business is entirely irrelevant because if the credit and debit items of the reciprocal transactions offset each other, no balance and consequently no international indebtedness is left over, and the transactions are without the slightest effect on the Balance.

There are two more factors to be considered in computing a correct statement of international insurance transactions: (i) unlicensed direct business and (ii) export and import of merchandise on CIF basis.

(i) In most countries insurance transactions with and by foreign companies not specifically licensed for transactions are legally prohibited and penalized. Nevertheless such transactions take place though their volume in most cases cannot be ascertained. It is unlikely, however, that they are of much importance. The very fact that such transactions cannot be based on a regular canvassing organization is likely to make them incidental. As a rule marine insurance and insurance against risks which cannot be covered in the country are exempted from the prohibition, and in those branches a considerable international business is going on, particularly with Lloyd's in London. The extent and geographical distribution of those operations defy, however, all private calculations.

(ii) The question of import and export conditions is from our point of view even more important, although it is not generally credited with the importance it merits. When goods are exported CIF the insurance will be effected by the seller and probably placed with insurers of his own country, insurance premiums being added to the price of the goods and paid for by the foreign buyer. Here again is an indirect form of taking insurance abroad. In spite of the importance of that item it has so

far received no proper attention in the estimates of the effect of insurance transactions on the Balance of Payments, though in some countries (Canada, Finland, France, Venezuela) it has been considered.

It may be clear now that the effect of international insurance transactions on the Balance of Payments of a country is extraordinarily complex, though some casual items (depots, initial cost of organization, etc.) have not been considered in order to avoid further complications.

IV

The problem being as complex as it is, everything depends on the adequacy and reliability of the basic material, on the general principles underlying the collection, computation and compilation of the statement, and upon the judgment and special knowledge of the compiler. The quality of the available statistical material and the qualifications of the compiler are an open question in each case. It is necessary to review some important points.

(1) The first question requiring early decision is whether the statement should be a current account of trade or an account of transfers, or in terms of accountancy should it be a revenue account or a cash account. We interpret here the Balance of Payments as an account of international indebtedness, in marked distinction to an account of transfers, as presented by some countries, whose figures are otherwise computed with admirable skill and competence. The question, what is the final net balance of a country's international insurance transactions, cannot be answered by the medium of an account based on actual transfers, because the time and amount of transfers are in no way in line with the profit or loss of the business. For many years profits from the business may be invested in the country of origin without being transferred or, again, losses may occur and be covered by funds at the disposal of the company in the country in question without actual transfers. On the other hand, a change in investment policy which causes a company to buy or sell securities in another country will result in transfers. For example, the very elaborate investigations in Canada and the United States reveal that the net equities of foreign insurance companies operating in those countries grew permanently in recent decades and they are now considerable indeed. It is very likely that this excess of assets over the liabilities of foreign companies in those countries entirely or partly represents accumulated profits reinvested in the country of origin. On the other hand, examples are not rare where the liabilities of foreign companies are in excess of their assets in the same country, indicating that they transferred some amounts for reasons of

investment policy, which some time have to be re-transferred to meet liabilities. For these reasons the balance of transfers cannot be a suitable medium for approaching the question of international indebtedness caused by insurance transactions.

(2) In some Balances of Payments, insurance figures embrace the transactions of foreign affiliated companies as well—with little justification. Reinsurance relations between the affiliated and mother companies are automatically included in the reinsurance accounts. Other transactions, like payment of dividends or buying shares, have nothing to do with insurance transactions proper. They are investment transactions of foreigners, like any other investments, and belong to the category of capital items.

(3) Very important is the proper consideration of the movement of the technical reserves, particularly in life insurance. It is common knowledge that between the income and expenditure of a going life insurance concern there is a wide gap, since individual life insurance to level premiums is a particular form of long-term saving. The excess of income over expenditure is, however, to a large extent not a profit to the company, but it has to be put aside as a trust amount to meet future liabilities. In most cases those amounts must not be taken out of the country of origin, though there are still a few exceptions to this rule. Obviously these amounts and a few similar items, in trade terms the movement of the insurance funds and technical reserves, have to be treated as expenditures. Should the transfer of such amounts not have been prohibited by law and should such transfers actually take place, the items belong to the category of capital movements and should not be included in trading balances.

(4) The business of a foreign insurance company written in a certain country may be, and as a matter of fact very often is, partly reinsured in the same country. All items regarding such reinsurance transactions are purely internal transactions and do not affect the Balance of Payments, but they do affect the ultimate trade result.

(5) Depreciations, profits and losses on investments and interests have to be considered whether they are connected with the insurance business proper or with the net equity of the company and they are to be treated accordingly as trade or capital items.

V

Though most countries compile and publish Balances of Payments, the insurance business is not always included in the sphere of investigations. Some others, again, do make investigations into the ques-

tion, but do not release the result of their findings or they do that in combination with some more items, like commissions and brokerages. The most elaborate investigations have been made by Canada and the United States. Both estimates are based on the transferred amounts. In some countries private compilations are supplementing official statistics or substituting it altogether.

Great Britain is among the countries combining insurance with commissions, etc., in her Balance of Payments. The yearly income of the country under this heading amounts to £35 to 40 millions of which 10 to 12 millions result from insurance operations overseas. That the question attracted the closest attention of the authorities has been made clear by an article in the *Journal of the Board of Trade*, No. 2213, Vol. 142 of May 5, 1939. Great Britain's insurance relations with the European countries were comparatively not so extensive as generally believed. They might have had a considerable aggregate volume, particularly in reinsurance, but they were based on reciprocity. The bulk of the foreign insurance business comes from the Empire Countries, from the United States and from Latin America. For many years the United States has contributed by far the largest part of the net revenue that the companies derived from abroad. Their American business forms a very large portion of the whole. In the fire branch it provides about 55 per cent of the premiums and in the accident branch about 40 per cent.[1] The remittances of branches and dividends of subsidiaries of British companies in the United States average $20 millions per annum.[2] According to American sources transfers in the last years were even greater.[3]

Switzerland is among the most important countries in international insurance business. Though it is well known that the Federal Insurance Supervising Office has repeatedly investigated the question, no official figures have been revealed. There are many private estimates, however, the most comprehensive of which, by Dr. R. Aeberhard,[4] amounts to 50 million Swissfrancs.

The German official figures show a debit balance of about 20 million Reichsmarks as the net result of the country's international insurance transactions in the last years before the present war. This statement is forthwith incredible and in contradiction to obvious facts. The explanation is that the figures are based on a fragmentary basis, embrac-

[1] *The Economist*, July 20, 1940.
[2] *The Economist*, October 25, 1941.
[3] Investigations of the Finance Division of the Bureau of Foreign and Domestic Commerce, compiled yearly by Dr. August Maffry.
[4] "Versicherungsverkehr," *Zeitschrift für Schweizerische Statistik und Volkswirtschaft*, 1935.

ing only the international direct business as far as they fall under government supervision. The true position is revealed, however, by a private author, E. Adrian.[5] According to that estimate Germany's profit from her international insurance trade was, prior to World War I, nearly 100 million Reichsmarks annually. In post-war time the profits were much lower, but progressively increasing.

No official Balance of Payments has been published in France. There is only a private source, the annually published estimates by M. M. Leonard Rist and Philippe Schwob.[6] They estimated the net credit balance of the international insurance transactions of France and her oversea territories (without Indo-China) at about 80 million Francs. The figures of the official insurance statistics in no way confirm the estimates of the authors and therefore the position is rather obscure. The same applies to Italy, too, a country without published Balances of Payments. The known insurance facts and figures justify, however, the assumption that Italian insurance business with foreign countries was in no case negative and very likely positive. Other European countries making official estimates about the subject are: Finland (Central Statistical Bureau and Bank of Finland), Bulgaria (Bulgarian National Bank and the State Control Office for Insurance) and the former small Baltic states. In all those countries the Balances of Payments are almost unaffected by insurance transactions.

From the overseas countries only the United States, Canada, Australia and Japan give estimates of the insurance transactions in their national Balances of Payments.

The case was very carefully investigated in the United States by Dr. August Maffry,[7] on behalf of the United States Department of Commerce. The methods and results of his investigations have been revealed in a comprehensive study covering the period 1919–1935. The investment aspects of the operations of foreign insurance companies in the United States were set forth in another study.[8] Since 1935 new surveys are made annually by the same compiler and published by the Finance Division of the Bureau of Foreign and Domestic Commerce. The latest publication relates to the year 1939. According to this latest report international insurance transactions affecting the United States

[5] "Das ausländische Versicherungsgeschäft," *Wirtschaftsdienst*, 1936.

Other works dealing with the subject are: *Die deutsche Zahlungsbilanz*, Berlin, 1930, Mittler; Wilhelm Kisskalt, *Privatversicherung und deutsche Zahlungsbilanz*, München, 1934; Robert Hafferberg, *Versicherung im Zahlenspiegel*, Die Bank, 1936/32; Alois Alzheimer, *Die deutschen Versicherungsgesellschaften im Auslande*, Berlin, 1939, Francke & Co.

[6] *Revue d'Economie Politique.*

[7] "Insurance Transactions in the Balance of International Payments of the U. S. 1919–1935," *Trade Information Bulletin*, No. 834.

[8] *Foreign Investments in the United States*, pp. 38–40, U. S. Department of Commerce, 1937.

involved a net movement of funds from the United States to the United Kingdom estimated at $31 millions in 1938 and at $28 millions in 1939. There was a net inflow of funds from Canada in 1938 of $11 millions and a net outflow in 1939 of about the same amount. Insurance transactions with all other foreign countries resulted in a net outflow of $5 millions in 1938 and in a net inflow of $2 millions in 1939. The net ultimate balances of all transactions in the 10 years 1929–1938 are given at: (in $ millions) 1929 +2.6, 1930 +11.3, 1931 +13.4, 1932 +8.1, 1933 −17.6, 1934 −18.8, 1935 −14.5, 1936 −26.8, 1937 +2.7, 1938 −15.6. The net debit balance for the whole period is, therefore, $55.2 millions. These estimates are based on actual transfers and probably rather far from the international indebtedness caused by insurance operations.

Canada's wide international insurance relations were first investigated from our point of view by Professor Viner[9] and later in a more elaborate study by the Dominion Bureau of Statistics.[10] The latter study is based on actual international remittances, too. The net balances of all international insurance transactions are estimated for the 10 year period 1929–1938 as at: (in $ millions) 1929 +19.0, 1930 +9.0, 1931 +34.0, 1932 −1.0, 1933 −1.0, 1934 +3.0, 1935 −18.0, 1936 −26.0, 1937 −10.8, 1938 −22.4. The net debit balance for the whole 10 year period is, therefore, $14.2 millions. As in the case of the United States this amount hardly gives a correct picture of the actual indebtedness of the country from insurance transactions.

Australia's international insurance transactions seem to be permanently negative to the Balance of Payments. The indebtedness caused by these transactions are estimated by the Commonwealth Statistician at about £1 million annually for the last ten years.

In Japan's official Balances of Payments an annual credit balance is estimated resulting from international insurance transactions, amounting to about 10 million Yens annually. As that amount roughly coincides with the debit balance of insurance transactions in Manchukuo's Balances it can hardly be regarded as an international item.

VI

To summarize, in no single country has an account been made according to our considerations. The different estimates differ considerably in method and merit and the available statistics are in most cases definitely inadequate. We are bound, therefore, to approach all figures

[9] *Canada's Balance of International Indebtedness, 1900–1913*, Harvard University Press, 1924.

[10] *The Canadian Balance of International Payments. A Study of Methods and Results*, Ottawa, 1939.

with caution and not to take them at their face value without critical examination. Anyhow, some obvious conclusions could be drawn without the risk of gross mistakes. These are:

(1) There are only a few countries the trend of whose international insurance transactions shows a distinct character. There is hardly any doubt that to Great Britain, Switzerland, Germany, and probably to France and Italy, insurance transactions are a permanent source of income from abroad, and on the other hand there are a few countries with permanently adverse balances. In most cases, however, the effect of the insurance business on the Balance of Payments is problematical and fluctuates widely from year to year both geographically and in amount. The period of the observation is in most cases too short and does not allow a definite judgment until the results of a longer period are available. Insurance has to spread the risks not only in space but in time also. All operations from the insurers' point of view are long-term operations, covering good years and bad ones and therefore the isolated consideration of some few years is a mistake in principle.

(2) Available statistics, which cannot be quoted here in detail, show that though the volume of direct insurance business is still a huge one, it is constantly decreasing, particularly in life insurance, and its effect on the Balances of Payments is diminishing alike. In any case the net result of the business is out of all proportion to its volume, and its importance to the Balance is in most cases grossly exaggerated.

(3) In reinsurance its international nature is a strong factor. But the post-war situation changed the situation in this respect as well. In the times before World War I reinsurance was for the most part the business of the professional reinsurers, established chiefly in the Central European countries. That does not mean of course that no direct writing companies accepted reinsurance business, but as a rule there was a distinct division between the business of insurers and reinsurers. The situation is quite different now. Direct insurance companies are very much interested in reinsurance and to some extent the professional reinsurers lost their hold on the business. They had to be content with sharing the business with direct offices and with adjusting their methods to the system of reciprocity which in gradual stages came into general use. The effect of this development from our point of view is that relations are bilateral now and compensating forces are at work to some extent. A onesided swing of the pendulum for any length of time is, therefore, unlikely. A further development of the inter-war period is the establishment of government reinsurance offices in some countries, namely in Turkey, Greece, Chile, Brazil, with the effect of diminishing the volume of that international trade considerably.

MEASUREMENT OF INDUSTRIAL PRODUCTION SINCE 1939

By Frank R. Garfield*
Board of Governors, Federal Reserve System

During the war years some of the usual differences of opinion about measurement of economic affairs have faded into the background. Everyone agrees there is now little unemployment. Meanwhile, certain other differences have been highlighted. Argument about the official cost of living index has been unprecedented and there has been more discussion than usual about the way industrial production is measured by the Federal Reserve Board's index.[1]

This highlighting of technical issues in certain fields reflects largely the fact that in a period of great change, decisions on technical matters are more debatable and make more difference than usual. It also reflects special concern about the social implications of levels indicated by particular indexes. Some observers suggest, for example, that if the index of industrial production is too high for the war years, people may be led to expect a volume of output after the war which would be quite unrealistic in view of the record of the past. Others note that if production figures are too low, current profits per unit of output may appear larger than they really are. Also, if production figures are far out of line in either direction, wage negotiations may be prejudiced.

Considering the unusual developments of the war period, index makers must reexamine their concepts, data, and techniques more often than usual and when they do they are likely to find important revisions required. In October 1943 a substantial upward revision was made in the Board's index of industrial production and since then many people have asked whether it might be too high, especially in 1942; but some think the index may still have a downward bias, particularly during the past year. From further information and study it appears that a few series, such as "other chemical products," are now too high but that some others, like aircraft and tobacco products, are too low. Any further

* This article is based largely on a paper presented at the Joint Regional Meeting of the American Statistical Association and the Institute of Mathematical Statistics, Washington, D. C., May 6, 1944.

[1] See: Clayton Gehman and Frank R. Garfield, "Revision of Industrial Production Index," *Federal Reserve Bulletin*, October 1943, pp. 940–952; *Survey of Current Business*, October 1943, pp. 6–8; *Business Week*, November 6, 1943, p. 112; *London Economist*, January 22, 1944, p. 111; *Cleveland Trust Bulletin*, February 15, 1944, p. 4; Geoffrey H. Moore, *Production of Industrial Materials in World Wars I and II*, National Bureau of Economic Research, Occasional Paper No. 18, March 1944; *New York Times* April 17, 1944, p. 22, May 4, 1944, p. 18, and May 22, 1944, p. 18; Irving H. Siegel, "The Concept of Productive Activity," this Journal, June 1944, pp. 218–228; Geoffrey H. Moore, "Measurement of Industrial Production in War and Peace," this Journal, September 1944, pp. 335–344.

revision, using the same general methods as heretofore, may well raise the index during 1943 and 1944.

The purpose of this discussion, however, is primarily to explore the effects of wartime changes on measurement of production. Changes, both in product and in process, have been much more rapid than in peacetime and have greatly complicated the problem of representing production in a particular industry by any single measure; in fact, they have made it difficult to maintain continuity in the definition of an industry. Moreover, new ways of doing things have altered somewhat the relative weights appropriate to particular activities, with changes during two or three years in some lines comparable to those of a decade in peacetime. Very practical questions arise as to how much these wartime changes have affected the index and how far adjustments have been made to take account of them. Are the various indexes for individual industries, groups, and the total approximately right, accurate enough to use in analysis and to publish?

Mr. Moore suggests that changes in products have been so drastic in some important lines that comparisons of output in these lines before the war and during the war are impossible and that, therefore, such comparisons for total industrial production cannot be satisfactory and should not be attempted.[2] Brigadier General Ayres doubts that there has been any such increase in the amount of fabrication per unit of material as he figures the Board's index implies.[3] Both of these critics attribute the vagaries of the index as they see them to the use of man-hour data, with certain adjustments, to measure fabrication of many finished products. On the other hand, the United Steel Workers of America challenge the Board's index of steel production on the ground that the particular physical measures used there (steel ingots, open hearth and electric) failed to reflect fully the rise resulting from increased finishing of steel ingots and the production of special steels.[4] Mr. Kuznets has raised some questions about the weights used and in a recent paper on gross national product has used a basically different weighting standard, reducing the importance of munitions and war construction considerably.[5] At the same time, Mr. Kuznets thinks that some of the series used in the Board's index understate the rise in output they are represented as measuring.

There are, then, a number of questions about the concepts, data, and

[2] Geoffrey H. Moore, *op. cit.*, pp. 42–50.

[3] *Cleveland Trust Bulletin*, February 15, 1944, p. 4.

[4] Brief submitted to Panel of National War Labor Board, Case No. 111-6230-D, 14-1, et al, p. 136.

[5] Simon Kuznets, *National Product, War and Prewar*, National Bureau of Economic Research, Occasional Paper No. 17, especially pp. 8 and 9.

methods used, the results shown, and the implications of these results for policy. Questions as to results relate mostly to the war period, but questions as to method date back in considerable part to the 1940 and 1941 revisions, and it appears essential to consider at the outset what the index is designed to measure and how the measurement is made.[6]

WHAT THE INDEX MEASURES

The index measures the physical volume of industrial production. "Industrial" is readily identified as referring here to factories and mines, including government arsenals and shipyards. But what is "the physical volume of production"? This question is elementary, important, seldom asked, and difficult to answer in straightforward terms. It is the first of a series to be discussed.

(1) If we look at a factory in operation, with managers, machines, and workers all engaged directly or indirectly in the process of transforming raw materials into finished products we get one view of production. If we look at a hundred factories in a hundred different industries we get a more complete view, seeing different men and different machines transforming different materials into different finished products. But how can we compare and add production in all these establishments currently or even for a single year? Actually, the comparison for one year (the weight year 1937) is made in terms of what companies have on their books and report to the Census. The difference between value of goods manufactured and the cost of materials, fuels, and supplies consumed approximates the amount paid to managers and workers for their services; to factory owners for the use of their land, plant and equipment, patents and trademarks; to creditors for the use of borrowed funds; and to the government for police protection and the like. This difference is called "value-added" and in the weight year 1937 each industry has an importance in the index corresponding with the "value-added" for that industry. This measure of importance would be a little more refined if services bought from other industries, like telephone and telegraph, were omitted. Perhaps a more important detail qualifying the accuracy of the results during the war period is the use for mineral weights of total value of product rather than value-added. But there are larger questions.

[6] See: *Federal Reserve Bulletins*—Frank R. Garfield and Paul Simpson, "Revision in the Index of Industrial Production," September 1941; "The Rise in the Federal Reserve Index of Production," October 1940; Woodlief Thomas and Maxwell R. Conklin, "Measurement of Production," September 1940; Maxwell R. Conklin, "New Federal Reserve Index of Industrial Production," August 1940; Frank R. Garfield, "General Indexes of Business Activity," June 1940. A version of this last article with bibliography appeared in *The Statistical Activities of the American Nations, 1940*, issued by the Inter-American Statistical Institute.

The value-added figures, used to establish the relative importance of various physical volume figures in 1937, are market facts, reflecting appraisals by all buyers and sellers, private and governmental, no matter how the appraisals were arrived at or how they were affected by income distribution, monopolistic practices, or the state of the industrial arts in various industries. Other standards might be used for weighting. The number of units of products might be counted, regardless of kind or value. Pounds of product might all be treated alike and, for comparison with tons of railroad freight originated, an index constructed that way might serve a purpose. The index maker might modify the value-added standard, dropping out things he regarded as of no consequence, perhaps putting a negative value on things he regarded as detrimental to the community. He might make adjustments for monopoly prices, if he wanted to and could determine monopoly effects, industry by industry. He might devise adjustments to make prices of "government-bound" products comparable with those of other products, if he believed, as Mr. Kuznets does, that there is an important difference.[7] Or he might work out adjustments for degree of maturity of each industry in the weight year in terms of scale of operations, degree of mechanization, or type of market; this is another factor Mr. Kuznets considers in reweighting war products. In the Board's index, it may be repeated, market appraisals of the contributions of the various factors of production are used as reported for 1937. This year was selected as fairly representative and the results would be practically the same using the only later Census, that for 1939.

With the relative importance of various industries established for the weight year 1937, changes in production from that year are measured by physical volume series, like those for tons of steel ingots and pairs of shoes produced, or their equivalent in terms of number of man-hours or machine-hours, adjusted to represent production. The index thus reflects changes from 1937 in the physical volume of production—less accurately in wartime when products and processes change rapidly—but does not reflect changes in the prices paid for products or for factors of production. The index is computed with the 1935–39 average equal to 100, but any other period might have been used, keeping 1937 as the weight year.

From this discussion of the meaning of the physical volume of industrial production it may be inferred that for the present purpose the specific character of the final product is not quite as crucial as is suggested by Mr. Moore's emphasis on the auto-tank valuation problem.

[7] Simon Kuznets, *op. cit.*, p. 8.

The discussion also indicates that the index is not one of "effort," notwithstanding the use of man-hour figures for limited purposes; in that term the contribution of labor is not adequately described, and that of machines is omitted. "Activity" is clearly more descriptive than "effort" but appears less meaningful than "production."

(2) The index corresponds after a fashion with gross national product expressed in constant dollars but covers only factories and mines and is arrived at through the use of physical volume series, with fixed weights, rather than of current value series adjusted for price changes. Production at factories and mines in peacetime constitutes about 30 per cent of gross national product and accounts for a considerably larger share of the fluctuations in output. Production for war purposes has been concentrated to a large extent in industry and some of the rise in industrial production has been at the expense of other activities like trade, whereas ordinarily increased industrial production is a factor stimulating increased activity in these other lines. Consequently, this index should show much more rise in wartime than gross national output in real terms. The actual increase in the Board's index as compared with various gross product figures is shown in Chart I, by six month periods.

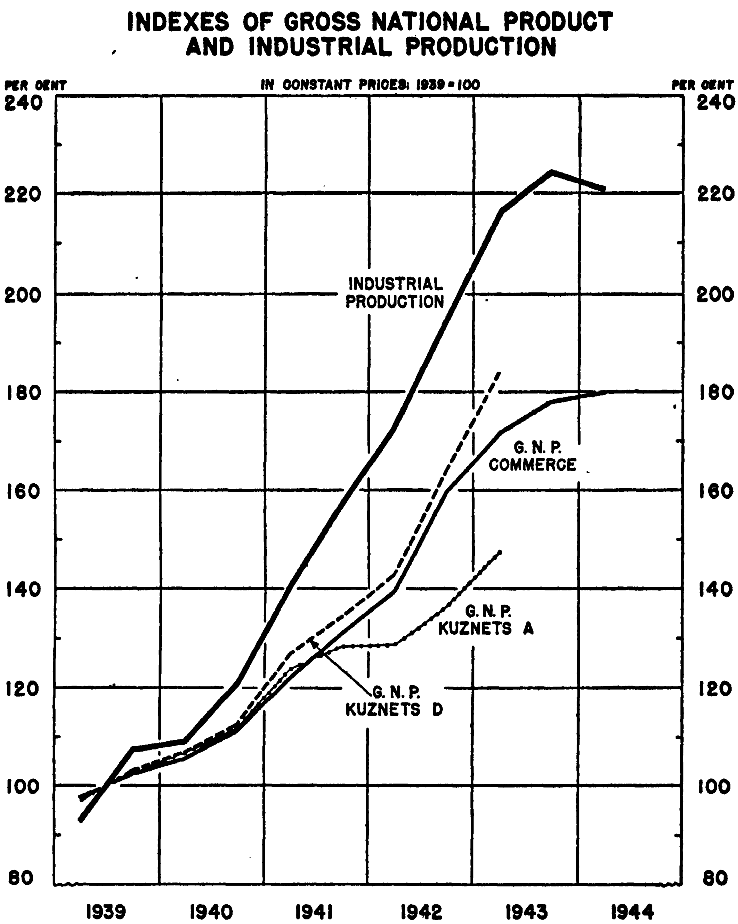
(3) The index is designed to measure production at all stages. Production of materials, not including those imported from abroad or produced in domestic agriculture, now accounts for about a third of the total, on one definition. Processing of materials, no matter where produced, accounts for two-thirds. At times it is important to distinguish the whole process from the final product; in the latter part of 1939, for example, this index rose more than an index of final product would have risen. And very often differences in timing between completion of particular finished products, such as battleships, and their production, as here defined, are substantial.

(4) The index is designed to measure production in each important industry and group of industries as well as in all industry. There are about 100 series in the index weighted to represent 18 principal Census industry groups. The series may also be grouped as consumer goods, producers' equipment and munitions, and materials. The wartime proportions of these groups are very different from the peacetime proportions, as Chart II indicates. This is to be remembered in comparing current levels with those in pre-war years or those likely or possible in post-war years. The composition of the total also needs to be considered in any study of changes in output per man-hour; value-added per man-hour is much greater in some industries than in others, nearly four times as much in chemicals, for example, as in textiles. Again, composi-

tion of the total is important to consider in any analysis of fabrication per unit of material consumed because this varies widely, being much greater in the munitions industries than in most other lines.

The attempt to measure changes in this much detail may serve to

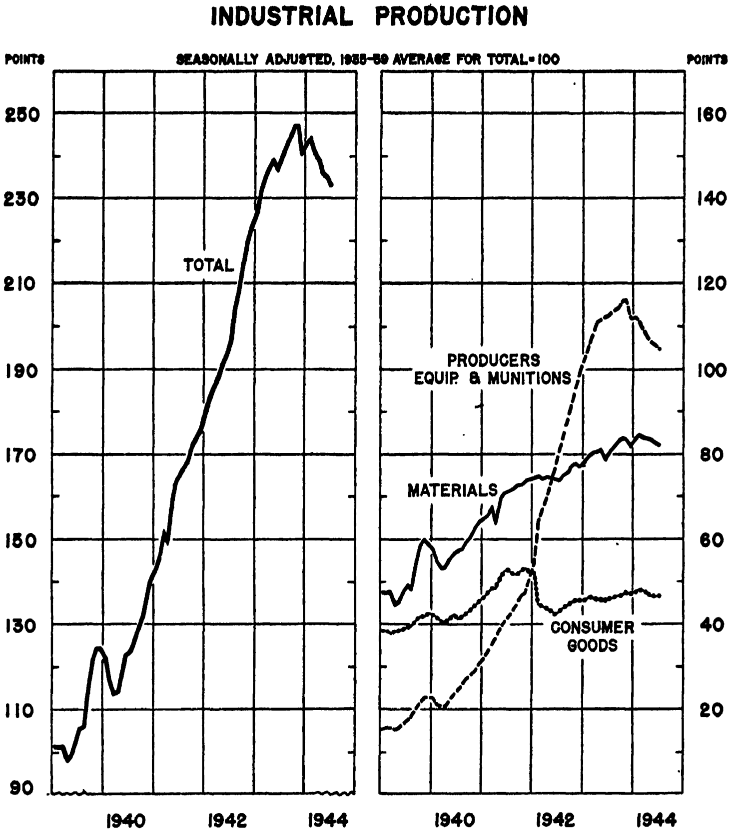
CHART I



NOTE.—The Kuznets A series for gross national product is based on his preferred assumption that efficiency in use of resources in munitions and war construction in the first half of 1943 was 20 per cent lower than in five war industries in 1939; and his calculation that, considering changes in efficiency from 1939 to the first half of 1943, efficiency in munitions and war construction in 1939 was 52 per cent lower than in five war industries in that year. The Kuznets D series "disregarding relative efficiency in war production," is based on the assumption (with which he disagrees) that efficiency in munitions and war construction in 1939 was the same as in the five war industries and upon the calculation that in the first half of 1943 it was 67 per cent greater than in five war industries in 1939. The Commerce figures for gross national product are estimated from annual figures and projected to the first half of 1944 by the author.

improve the total index, unless perchance it diverts too much attention from broad issues to problems of detail. This approach also permits fairly detailed examination of the area of controversy and, perhaps, some narrowing of differences in view.

CHART II



NOTE.—"Producers equipment and munitions" includes the iron and steel group, exclusive of pig iron and the steel subgroup; machinery; manufacturing arsenals and depots; transportation equipment; and explosives and ammunition; prior to February 1942, however, the automobile industry was included in the consumer goods group. "Consumer goods" includes furniture; the textile group, exclusive of fabrics; shoes; manufactured foods; alcoholic beverages; tobacco products; fine and tissue paper; printing and publishing; soap; drugs and cosmetics; rubber products; anthracite; and, for the period from 1939 up to February 1942, automobiles. All other series are in the "materials" group. The weights are those of the industrial production index.

HOW THE MEASUREMENT IS MADE

The index actually compiled relates of necessity to the changing industrial scene and is based on available data, both current and benchmark. Frequently because data are scarce it is necessary to use series

which are not Grade A; then when better information becomes available a revision is in order. In the extreme case of chemicals, the introduction last autumn of newly developed current data (and of 1939 Census data which had become available after the 1940 revision) raised the chemicals index sharply and contributed 11 points to the 36 point upward revision of the total index for July 1943. Lack of comprehensive benchmark data since 1939 has definitely limited analysis both of series and weighting problems.

In using current data several tasks are undertaken. One is to check the accuracy of the data for what they are; another is to see how well they represent the industry in question as to level and monthly fluctuations; a third is to make necessary adjustments, particularly to levels established biennially, annually, or quarterly by more comprehensive measures; and a fourth is to make allowances in the series accepted for non-working days and usual seasonal variations. In the war period seasonal adjustments in many lines are not required and changes in daily average adjustments can be handled without too much trouble. The really important tasks are to test the measures used and to make such adjustments as seem to be indicated. In peacetime the comprehensive study of manufacturing production made by Mr. Fabricant on the basis of Census data provides many useful checks.[8] In wartime no general Census has been taken. The 1942 Census for lumber, however, was the best ever taken and in some lines, such as chemicals, foods, and nonferrous metals, improved current information has been available. In most other lines there has been a variety of information, often compiled for administrative purposes, about units produced, materials consumed, man-hours worked, machinery installed and utilized, dollar value of shipments, price changes, and the like.

Of necessity certain special decisions about weights have been made where new products have been introduced. The automobile industry, for example, is now manufacturing mostly aircraft engines and parts, and other products not in the value-added figures for that industry in 1937. It has been figured that on the average a man-hour in this industry represented as much production, in the sense of value-added at 1937 prices, right after the transition, as it did before. In 1937, value-added per man-hour (wage-earners only) in the production of automobiles was about $1.75 as compared with $1.80 in the production of aircraft engines and $1.35 in the production of aircraft, excluding engines. In most

[8] Solomon Fabricant, *The Output of Manufacturing Industries, 1899–1937*, National Bureau of Economic Research, 1940, and unpublished study for 1939. For an analysis of mining see Harold Barger and Sam H. Schurr, *The Mining Industries 1899–1939: A Study of Output, Employment, and Productivity*, National Bureau of Economic Research, 1944. Geoffrey H. Moore, *op. cit.*, p. 35, has combined these series for manufacturing and mining.

other industries whose products have changed considerably the same procedure has been used; in a few lines, especially chemicals and petroleum products, rough direct estimates of weights appropriate for new products have been made. This is then the procedure used for handling a situation which has been difficult, but fortunately not quite so difficult as if the transition had been even more radical; if, say, the textile industry had shifted to production of aircraft. The automobile industry was asked to make particular new products primarily because the processes involved were similar in important respects to those with which the automobile industry was familiar.

The discussion of what the index measures and how the measurement is made has suggested some of the answers to various questions about measurement of wartime production. Consideration of the whole set of issues may be continued by examining the nature of important series and exploring various weighting problems.

SERIES ACCEPTED AND UNDER DISCUSSION

Only minor questions have been raised concerning the accuracy of series currently used to represent production in a wide variety of industries accounting for 65 points in the index in 1935–39 and 95 points in the year 1943. Such revisions as might properly be made in these lines would be fairly small; in the aggregate they might raise the 1943 total somewhat.

That leaves for consideration series accounting for 35 points in the base period and 144 points in 1943. This group consists of the principal series in which man-hour data are used, plus iron and steel. It consists also almost entirely of war products. The importance of various series under discussion is shown in the table.

INDUSTRIAL PRODUCTION

(Points in total index)

	1935–39 average	1939	December 1941*	1943
Total index	100.0	108.6	176.0	238.9
Accepted	64.6	70.2	93.1	95.2
Under discussion (below)	35.4	38.4	82.9	143.7
Iron and steel	11.0	12.5	21.0	22.8
Machinery	10.8	11.2	28.4	47.8
Transportation equipment	5.9	6.1	18.3	45.8
Automobiles	4.8	4.5	6.6	10.6
Aircraft and shipbuilding	.8	1.3	10.6	33.8
Railroad cars and locomotives	.3	.3	1.1	1.3
Chemicals	6.3	7.0	12.9	24.1
Rubber products	1.4	1.6	2.3	3.2

* Adjusted for seasonal variation.

In the iron and steel group the use of separate measures for open hearth and electric steel has largely met one of the most serious problems of change in product. There is real question, however, how appropriate the use of pig iron and the open hearth steel series is to represent fabricating activities in the iron and steel products industries, excluding specialized ordnance plants covered elsewhere. If man-hours worked in the regular fabricating plants were to be used instead, without any allowance for change in output per man-hour, a larger rise would be shown for the total iron and steel group. This is an instance in which physical volume figures excellent for some purposes may not be adequate for other purposes and where increased fabrication per unit of material may not have been reflected in the index. If the iron and steel group were to be listed without change in the "accepted" group, the total for that group would be 76 points in the base period and 118 points in 1943.

In the machinery industry the figures show production in 1943 over four times that in the base period, with about half the rise occurring by December 1941. A considerable part of this increase was in plants producing aircraft engines; excluding these, the level would be about three and one-half times that in the base period, with over half of the rise coming by December 1941. A considerable part of the remaining rise was in other war products, such as artillery and artillery shells, ship engines, and radar. There is, moreover, ample evidence that production of industrial equipment has been very greatly expanded to meet war requirements. By comparison the effect of reductions in output in this industry of some civilian items like electric refrigerators and sewing machines has been very small. That there has been, net, a very large increase in production in the machinery industry can hardly be questioned.

The increase actually shown for the whole machinery group reflects a rise in man-hours reported, and allowances amounting by 1943 to 5 per cent for underreporting of employment and 15 per cent for increased output per man-hour. This 15 per cent is not a measure of increase in labor productivity and should not be taken as representing the increased contribution of labor. It is simply an overall estimate of what has happened to production per man-hour as a result of many developments, including introduction of new machinery and techniques made possible by a sustained large-scale demand. Some factors such as the long working hours and the employment of inexperienced workers tend to lower output per man-hour, offsetting part of the gains from other sources. This allowance was determined through study of various

sorts of information regarding production, shipments, and the like during the war period as well as through study of broad changes in output per man-hour before the war. It is only an approximation.

It is, however, probably a much closer approximation than could be obtained by using simply volume of materials or tonnage of products, if such figures were available. Many of the new products made in this industry are exceedingly intricate and must be made to the highest specifications to meet the exacting requirements of war production and combat use. Lightness and compactness have been stressed to facilitate transport and use of munitions. All in all there has been a large increase in fabrication per unit of material in industries such as this. Further study of War Production Board records is being made to improve understanding of what has been going on in the machinery industry and also in other metal fabricating industries.

In the transportation equipment group, production has risen to about seven and one-half times the pre-war level, according to the index. Production in the automobile industry has more than doubled; in the railroad equipment industries has quadrupled; and in the aircraft and shipbuilding industries combined has risen to a level more than 40 times what it was. The difficulties of wartime measurement are illustrated in the automobile industry where consumption of steel is very much less than before the war while dollar volume of shipments is very much greater. Part of the difference reflects use of different materials, part an increase in fabrication, part a rise in prices. The increase in output per man-hour allowed for is 8 per cent from the base period, 5 per cent from 1939. This is the industry which some people have chiefly in mind when they say the total index was too high in the spring of 1942. At that time employment was considerably reduced and the Board's index for this industry, at 130 per cent of the 1935–39 average, was about a fourth below the peak of the preceding summer. Perhaps a third of this remaining production was of trucks and of special war products whose output was already well established. Any special temporary adjustment for inefficient operation would thus have applied to man-hours representing about 4 points and would have lowered the total index only slightly. If allowances of this sort had been made generally, the index would have risen somewhat less rapidly in the early part of 1942, more rapidly later.

Production in the aircraft and shipbuilding industries accounted for less than 1 point in the total index in the base period and for 34 points in 1943. Current changes shown are based on man-hour series with upward adjustments for underreporting and allowances of about 22 per

cent for increases in output per man-hour from the base period. Other available series relate to final products, and also, in shipbuilding, to work in place. From 1941 to 1943, according to the War Production Board, deliveries of military aircraft rose $3\frac{1}{3}$ times in number and $7\frac{2}{3}$ times in pounds of airframe weight. The more rapid rise shown by weight reflected an increasing proportion of bombers. In this same period the Board's index for production in the aircraft industry rose about $3\frac{1}{3}$ times. This figure, however, is not directly comparable with the preceding figures. In 1941 the Board's series included a considerable number of civilian craft. Allowing for this, the Board's implied measure of military craft would be up over 4 times. Making a further adjustment to put the Board's figure on a delivery basis and include production of parts outside the aircraft industry, as defined in the Board's index, the rise might be about $6\frac{1}{3}$ times. This is much more than the rise in number of military aircraft delivered but not as much as the rise in airframe weight. It is about the same as the rise shown by the War Production Board index of all military aircraft production, in August 1943 prices, but somewhat lower than that index would be if airplane engine production were excluded, as it is from the various figures cited above. Altogether, it appears that the Board's index of production in the aircraft industry rose less from 1941 to 1943 than production in that industry. The 1941 figure seems reasonable as compared with the base period.

In shipbuilding the rise shown by the Board's figures from 1941 to 1943 was less than that shown by the War Production Board index for estimated work in place, in August 1943 prices. Ship deliveries rose more percentagewise than work in place but were not closely related to production figures in the period of rapid change under review because of the long and changing time involved in ship construction.

The rise shown by the chemical group to a level in 1943 nearly four times that of the base period accounted for 18 points of the rise of 139 points in the total index. The group figures are based on separate series for industrial chemicals, which rose at about the same rate as the whole group; explosives and ammunition (small arms); several components such as paints, soap, rayon, and drugs; and "other chemicals." The series used prior to the revision in October 1943 was for the chemicals group as a whole, and before the 1940 revision chemicals were assumed to move with the total index (as miscellaneous industries accounting for 3 per cent of manufactures are now). The series for industrial chemicals is based on over 50 annual and quarterly physical volume series moved from month to month and kept up to date by man-hour series, adjusted. The man-hour series for explosives and small arms ammunition are adjusted partly to physical volume data, partly to estimates

derived from study of other figures. New figures and further analysis indicate that the series for "other chemical products" shows more rise than it should. In the chemical field new products are an important factor difficult to appraise.

The rubber products series, a straight man-hour series since March 1941, is not regarded as very satisfactory, owing partly to classification problems, but is more satisfactory than rubber consumption for the period when output of products using little or no rubber was an important part of the total.

Reviewing the list, it appears that the elements of change are great but that in each industry there are important features of continuity in the management, the working force, and the whole production process and that approximate answers can be obtained by study of all available information.

MATERIALS AND FINISHED PRODUCTS

This approach seems definitely preferable to estimating the total by assigning finished product weights to raw material production series, either industry by industry or on an overall basis. Materials production appears not to represent production in many of these important finished product lines where war output has increased most. This is largely because increases in fabrication per unit of material have been considerable in these lines, accounting for much of the rise in fabrication per unit of material implied for the index as a whole.[9] The drift toward more fabrication was already evident before the war and, therefore, the fact that from 1939 to 1943 the materials production index constructed by Mr. Moore showed a rise of only 37 per cent as contrasted with 120 per cent in the Board's index does not necessarily indicate too much rise in the Board's index. Further, if revisions were made in this materials index to take account of synthetic materials and the like, it would rise 45 per cent or more. Then if it were reweighted to make materials represent their respective finished products, the rise would be greater, perhaps 60 per cent or more, without allowance for changes in consumption of materials, as contrasted with production, or for changes in the amount of fabrication per unit of material.

[9] The increase of 5½ times as much in finished product as in materials by 1943, attributed to the Board's index in the *Cleveland Trust Bulletin* for February 15, 1944, reflects partly doubtful classification of items (no chemicals were included in the materials group); and comparison with 1940 levels (without reference to accumulation of materials inventories that year). Making the comparison with a different classification and with 1935–39 the rise is about 3 times as much for finished products as for materials. Then considering the matter in terms of degree of fabrication per unit of material, the rise shown from 1935–39 period is ⅔. This figure is not regarded, however, as a satisfactory measure because no adjustments have been made for imports and exports of materials, for unfinished materials used outside industry or for weighting difficulties which limit the meaning of any such comparison.

PLANT CAPACITY AND UTILIZATION

Considering the plausibility of the Board's index from another overall approach, note may be taken of the increase in use of plant and equipment as well as of the increase in man-hours worked. Most of the rise in output through 1941 reflected increased utilization of existing plant, as relatively little new plant had come into operation by that time. Little question has been raised concerning the index level of 175 for the end of that year, about 60 per cent above the 1939 level. During 1942 and 1943 utilization of existing plant (net of some reductions) increased considerably further and toward 20 billion dollars of new plant and equipment of most modern design was added. Difficulties in the way of determining how much this meant in terms of capacity are great but it appears that the expansion was probably 35 per cent or more. A rough calculation suggests that additions to capacity and increases in plant utilization by the end of 1943 were large enough, with man-hours meanwhile rising about 35 per cent, to permit the 40 per cent further rise shown in the Board's index from the level of 175 at the end of 1941 to the peak of 247 in the autumn of 1943.

In passing, it may be noted that overall comparisons are likely to be rough and that full use of such data as those on plant capacity, munitions output, shipments, and electric power consumption in industry can be made only on a detailed industry by industry basis. Attempts, for example, to use the War Production Board's index of finished munitions output to check the aggregate of munitions production scattered through the Board's series have yielded only broad indications as to the accuracy of the Board's representation of munitions output. This is especially true for 1942, the year most under discussion. In general such comparisons, with approximate allowances for this and that, suggest that the Board's index has not fully reflected the rise in munitions production; further work is to be done, however, in refining these comparisons.

ADVANCING INDUSTRIAL TECHNIQUES AND OBSOLESCENT WEIGHTS

In 1939 an automobile could be produced much more easily than in 1899 and many more were actually produced, to sell at prices (net of materials cost) much lower relative to prices of most other products than in 1899. The production of a single car was therefore much less important as an element of value-added in 1939 and a weighting system which used 1899 weights would have given too much importance to the rise in automobile production in the interval. With 1939 weights the rise would have had too little importance. The usual procedure would

be to compromise by using different weights for different periods or perhaps base year and given year weights for the same period. The war period of a few years may be likened, for the aircraft industry, to a decade or so and weights established six years earlier may seem out of line for 1943. Techniques in numerous other industries have also improved. Is a new set of weights in order?

The answer depends largely on what has happened to capital costs, wages, and value-added per unit (of comparable quality); what information about these matters is available; how important the whole issue may be; and how appropriate various weights might be for the period ahead as well as for the war period to date.

Mr. Kuznets, facing similar problems for gross national product, sets up a new standard for the munitions and war construction component. He reduces the importance of such production in 1939 by one-half because it was government-bound and carried on in immature industries, without presenting evidence on the relative prices of government-bound products and without saying much about standards used for judging degree of maturity. In effect he brings estimated economies of the large-scale operations of wartime back into 1939 for purposes of weighting, without including in the weights any of the special taxes or differentially increased wage rates which often go with profitable large-scale operations as actually developed. Or, looking at it another way, he brings back to 1939 certain developments which might have occurred in peacetime over an indefinitely long period, but presumably along with numerous other changes not mentioned. This reweighting is done only for the entire munitions and war construction group, not for any particular industry. Weights are not crossed, nor are adjustments made for relative inefficiency in certain other parts of the economy whose output has increased relatively little. The standards used, so far as they are set forth, do not appear adequate for meeting wartime weighting problems, at least as presented in the index of industrial production.

A basic fact to consider is that data available for 1943 are not adequate to permit a detailed study of the effects on value-added of changes in products, improvements in technique, increased utilization of plant, differential wage changes, and the like. Of less importance, the value-added figures, if available, would need very special interpretation because of price renegotiation allowances, classification problems, and the like. In any event, new weights could be regarded as typical only of a short period and would need to be crossed with pre-war weights. Some of the changes in weights would be offsetting in their effects on the level of the total index. All in all the effect of changing weights on a broad

estimating basis might be to lower the index for the war years but not enough to affect greatly the comparison between pre-war and war levels of production; meanwhile, as indicated earlier, revisions in series would probably tend to raise the index. The discussion of weights for the war period may well continue for a long time, even after some additional wartime data become available. A general revision of weights will be essential when returns from the first comprehensive post-war Census are available.

CONCLUSION

Changes in the industrial economy since 1939 have been rapid and widespread, greatly complicating the problem of measuring industrial production. An attempt has been made in the Board's index to take account of new developments as far as available information would permit. In the nature of the case the measurements for the total and for some of the parts are less accurate than those of peacetime but it is believed they are good approximations and that the index is a useful tool for analysis of war and post-war developments. A basic conclusion to be derived from the wartime record is that the productive capacity of industry is much greater than anyone had supposed. Conditions during the war period, however, have been very different from those of peacetime with respect to the type of product, the degree of fabrication, the market, the composition of the labor force, average hours worked, and the concentration of economic activity in industry. These differences need to be kept in mind in considering post-war production potentials; so also, if reference is made to developments a quarter of a century ago, should differences between the course of industrial production in this war and in the last war. No adequate measure of total industrial output is available for the first world war but it appears that the increase this time has been very much greater and that a much larger part of the increase has been in the production of highly fabricated precision equipment for use in combat and production. The Board's index can be most useful, perhaps, in studying post-war conditions, if people who refer to it take note of what happens in particular industries as well as in the total and make allowances in their comparisons from one period to another for important changes in surrounding conditions.

ECONOMIC CONSUMPTION SCALES AND THEIR USES*

By Robert Morse Woodbury
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Twenty years have elapsed since Sydenstricker and King published their study on the Measurement of the Relative Economic Status of Families[1] and ten years since their consumption scale, "a device for measuring the size of families," was subjected to critical appraisal in *Methods in Social Science: A Case Book.*[2] During this period important developments have taken place in this field. A review of the status of consumption unit analysis in the light of these new researches is of interest from several points of view.

Sydenstricker and King were interested in the consumption scale as a tool in the problem of more precise measurement of the relative economic status of families. In studying the health of families in a social survey, the need was felt for some method of classifying families according to economic status in order to ascertain, if possible with numerical results, the influence of economic position upon health and morbidity. The existing consumption scales, based for the most part upon relative requirements of adults and children in terms of calories, seemed to Sydenstricker and King in need of refinement for purposes of their analysis, and they developed a technique by which a new set of values was obtained to express the relative consumption of adults and children of different age and sex on the basis of evidence of actual expenditures on food and on all items by families of varying composition. With this improved scale they were in a position to calculate the expenditures of each family per consumption unit and then to classify the families in expenditure-per-consumption-unit groups. In this process, the consumption scale is a measuring rod of relative consumption, in expenditure terms, of food and of all items, by persons of different age and sex expressed as a percentage of the consumption of the adult male.[3]

In his critique, Professor Ogburn devoted special attention to the

* This paper represents part of an International Labour Office study of consumption unit analysis which is at present in preparation. Cf. also, *Methods of Family Living Studies*, International Labour Office Studies and Reports Series N, No. 23 (Geneva, 1940), pp. 75–77.

[1] Edgar Sydenstricker and Willford I. King, "The Measurement of the Relative Economic Status of Families," *Quarterly Publications of the American Statistical Association*, Vol. XVII, No. 125, September 1921, 842–57.

[2] William F. Ogburn, "A Device for Measuring the Size of Families, Invented by Edgar Sydenstricker and W. I. King," in *Methods in Social Science: A Case Book.* Edited by Stuart A. Rice, University of Chicago Press, Chicago, Ill.

[3] In the Sydenstricker and King Scale, the unit is the consumption of the adult male 25 years old, at which age consumption was found to be at the maximum.

techniques by which the original scale (the Atwater scale based upon calories[4]) was adjusted to the expenditures of the local population group. He pointed out that theoretically each locality with its special consumption habits and local prices would have its own consumption scale: and hence, if a scale based upon a particular local group was actually to be applied generally, evidence was necessary to show that the variations, due to local differences, in scales developed for different communities were not large enough to invalidate their wider applicability. Ogburn characterized the procedure as a method of measuring "family size": the size varying according to the purpose—e.g., relative food costs, relative total expenses—and according to circumstances, such as differences in income classes, times and places.[5]

In discussing the developments which have taken place since Sydenstricker and King's article, the simplest procedure is to present the various scales which have been proposed and then to discuss them with relation to present day problems and points of view concerning economic consumption scales. At the outset, however, attention may be directed to three developments in regard to nutrition scales[6] which may help to orient the discussion. In the field of nutrition scales important developments include (1) adoption of scales for specific food elements, (2) reliance upon requirements rather than consumption and (3) a movement towards comparability and standardization. In regard to the first point separate scales are available for calories, protein, calcium, iron and other minerals, and the several vitamins. Since the purpose of the scales is, in effect, to calculate the requirements of a population group for the different food elements from the data of sex and age distribution, to compare needs with available supply or consumption with requirements, the use of requirements as a basis for determining scale values is obviously indicated. The work of the Health Organization of the League of Nations in setting up standard calorie scales and of the Food and Nutrition Board of the U. S. National Research Council in setting up standard scales for the various food elements, illustrates the trend towards standardization; and comparability may be achieved by means of conversion to standard scales, provided that data as to the sex and age composition of the population group surveyed are given. From these data, in conjunction with the scale actually used in each study, the requirements of various food elements for the popula-

[4] *Farmers' Bulletin* 142, p. 33, published by U. S. Dept. of Agriculture.

[5] "New scales should be drawn up for different income classes and different times and places . . . " (*Ibid.*, p. 217). The point was also raised whether a new scale should be constituted for each study (*Ibid.*, p. 218).

[6] A differentiation is made between nutrition scales for food elements and the economic scales to which latter the present article is devoted.

tion group of each study can be estimated according to any desired scale, and hence on a basis that permits of valid comparisons with the results of other studies.

Sydenstricker and King rejected a nutrition or calorie basis for an economic or expenditure scale; and moved in the direction of greater specificity in adopting separate scales for food expenditures, for expenditures on all other items than food and for general expenditures. Their scale for general expenditures was derived from the other two by weighting by the average expenditure on food and all other items. Their technique utilizing the data of their particular study to derive a scale for that study may be said to give an "autogenous" scale. They tested it by applying it to additional materials obtained from the same source and drew the conclusion that the scale was applicable to the same class in the same locality, though subject perhaps to inaccuracy if applied to other classes in that locality or to the same class in other localities.[7] They applied their scale to the calculation of the number of consumption units in each family as a step in the classification of families according to income per unit. In such a classification the objective is a differentiation of the families into a small number of groups ranged according to income per unit, in which small errors in the allocation of individual families are not of vital consequence. So far as standardization is concerned, the difficulties of standardization, with this type of indirect application, include not only the adoption of a uniform or equivalent scale but also of uniform or equivalent class limits to incomes and are especially great as between different localities with different consumption habits or where different currencies complicate the identification of levels of living in terms of income per unit. So far as conversion to a common basis is concerned, such conversion from one scale to another is feasible only where the scales enter into the final results directly, to show, for example, the total number of consumption units in a population group, but not where they enter indirectly as in the case of classification of families according to income per unit.

In the next paragraphs the new scales which have been developed are set forth, followed by a discussion of new developments in the application of economic scales to new problems.

Table I presents eleven food expenditure or cost scales developed subsequent to the Sydenstricker-King scale.[8] Most of these are based on actual food expenditures. Those of Stiebeling and Ward for a liberal

[7] The scale might prove "somewhat inaccurate if applied to different classes of persons" than the cotton mill workers in the locality under consideration "or to the same class in other localities." *Op. cit.*, p. 855.

[8] Scales based on calories or energy requirements are not included.

TABLE I
FOOD EXPENDITURE AND COST SCALES*

Age	Sydenstricker and King†		Williams and Lockwood¶		Germany Statistisches Reichsamt**		UNITED STATES: Wage earner study: average prices of††						Consumer purchases study***		Dept. of Agriculture (Stiebeling and Ward)§§§: Liberal diet		Adequate diet: Moderate cost		Adequate diet: Minimum cost		Restricted diet: For emergency use		Heller Committee¶¶¶	
	1917		1925–27		1927–28		1934		1 June 1934–31 May 1935		1935		1936–37		1933		1933		1933		1933		1937	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Under 1 Year	0.28	0.27	0.37		0.50		0.51		0.48		0.48		0.51		0.47		0.53		0.71		0.61		0.765	
1	.30	.29	.37		.50		.51		.48		.48		.54		.47		.53		.71		.61		.765	
2	.35	.34	.42	.40	.50		.54		.52		.51		.55		.47		.53		.71		.61		.765	
3	.38	.37	.47	.42	.50		.54		.52		.51		.59	.58	.47		.53		.71		.61		.754	
4	.41	.40	.50	.44	.50		.61		.59		.58		.61	.60	.56		.61		.78		.72		.754	
5	.44	.43	.52	.47	.50		.61		.59		.58		.65	.63	.56		.61		.78		.72		.754	
6	.46	.45	.55	.49	.50		.61		.59		.58		.73	.67	.56		.61		.78		.72		.776	
7	.48	.46	.57	.51	.50		.79	.61	.77	.59	.76	.58	.80	.73	.71	.56	.74	.61	.83	.78	.86	.72	.776	
8	.51	.48	.60	.52	.50		.79	.79	.77	.77	.76	.76	.87	.79	.71	.71	.74	.74	.83	.83	.86	.86	.776	
9	.53	.49	.63	.55	.50		.86	.79	.84	.77	.84	.76	.91	.84	.77	.71	.83	.74	.91	.83	.92	.86	.929	
10	.56	.52	.71	.58	.75		.86	.79	.84	.77	.84	.76	.95	.88	.77	.71	.83	.74	.91	.83	.92	.86	.929	
11	.59	.54	.78	.60	.75		.92	.86	.91	.84	.90	.84	.98	.90	.85	.77	.89	.83	.96	.91	.97	.92	.929	
12	.64	.58	.80	.63	.75		.92	.86	.91	.84	.90	.84	1.03	.93	.85	.77	.89	.83	.96	.91	.97	.92	.929	
13	.69	.62	.82	.66	.75		1.01	.86	1.00	.84	1.00	.84	1.07	.97	1.04	.77	1.09	.83	1.10	.91	1.13	.92	.929	
14	.77	.66	.85	.69	.75		1.01	.92	1.00	.91	1.00	.90	1.12	1.01	1.04	.85	1.09	.89	1.10	.96	1.13	.97	1.235	1.00
15	.84	.72	.88	.72	1.00	.90	1.01	.92	1.00	.91	1.00	.90	1.12	1.01	1.04	.85	1.09	.89	1.10	.96	1.13	.97	1.235	1.00
16	.90	.76	1.03	.75			1.02	.92	1.02	.91	1.02	.90	1.14	1.01	1.13	.85	1.17	.89	1.17	.96	1.24	.97	1.235	1.00
17	.94	.80					1.02	.92	1.02	.91	1.02	.90	1.14	1.01									1.235	1.00
18	.97	.82					1.02	.92	1.02	.91	1.02	.90	1.14	1.01									1.235	1.00
19	.98	.84					1.02	.92	1.02	.91	1.02	.90	1.14	1.01									1.00	.902
20	.99	.85					1.02‡‡	.83§§	1.00‡‡	.83§§	1.00¶¶	.90§§	1.00†††	.92‡‡‡										
21	1.00	.85																						
22	1.00‡	.86§																						
Adult: moderately active			1.00	.78											1.00	.85	1.00	.89	1.00	.96	1.00	.97	1.00	.902
very active			1.25	.85											1.17	1.04	1.13	1.09	1.12	1.10	1.28	1.13		

* Except when otherwise noted, the last figures shown apply also to higher wages. † Edgar Sydenstricker and Willford I. King, "The Measurement of the Relative Economic Status of Families," *Quarterly Publication of the American Statistical Association*, Vol. XVII, No. 135, Sept. 1921, p. 849. ‡ For years over 22: 23–44, 1.00; 45–48, .99; 49–51, .98; 52–54, .97; 55–57, .96; 58–60, .95; 61–64, .94; 65–69, .93; 70–74, .92; 75–79, .91; 80, .90. § For years over 22: 23–43, .86; 44–47, .85; 48–50, .84; 51–53, .83; 54–57, .82; 58–60, .81; 61–63, .80; 64–68, .79; 69–74, .78; 75–80, .77. ¶ F. M. Williams, and J. E. Lockwood, An Economic Study of Food Consumed by Farm and Village Families in Central New York, N. Y. (Cornell) Agricultural Experiment Station Bull. No. 502, (1930). ** Germany. Statistisches Reichsamt. "Die Lebenshaltung von 2,000 Arbeiter-, Angestellten-, und Beamtenhaushaltungen"; *Einzelschriften zur Statistik des Deutschen Reiches*, No. 22, 2 vols. Berlin, 1932. †† Scale of customary food expenditures, Estimates of the Bureau of Home Economics—Bureau of Labor Statistics. F. M. Williams and Alice C. Hanson, *Money Disbursements of Wage Earners and Clerical Workers 1934–36*. Summary Volume. U. S. Bureau of Labor Statistics, Bull. 638, p. 363. ‡‡ Full-time employed; for unemployed and part-time employed, 0.90. §§ Moderately active; for women 20 and over, active, 0.92. ¶¶ Full-time employed; for unemployed and part-time employed, .89 *** Hazel K. Stiebeling, Day Monroe, Esther F. Phipard, Sadye F. Adelson and Faith Clark, Family Food Consumption and Dietary Levels. Five Regions, U. S. Department of Agriculture, Misc. Publ. No. 452, p. 251. ††† Moderately active; for active, 1.12. For ages 75 and over, 0.90 for moderately active, 0.95 for active. ‡‡‡ Moderately active; for active, 1.00. For ages 75 and over, 0.85 for moderately active, 0.90 for active. §§§ H. K. Stiebeling, and M. M. Ward, Diets at Four Levels of Nutritive Content and Cost. U. S. Dept. of Agriculture, Circular No. 296, p. 26. (1933). ¶¶¶ Emily Harriet Huntington, and Mary Gorringe Luck, Living on a Moderate Income: the incomes and expenditures of street-car men's and clerks' families in the San Francisco Bay Region, with an Introduction by Bruno Lasker; a report in the International Research series of the Institute of Pacific Relations. Berkeley, Cal., University of California Press 1937. Appendix A. The figures give relative costs of a minimum standard diet for persons of different age and sex, the adult male (moderately active) = 1. (The figure for sedentary adult males = .902.)

diet, adequate diet and restricted diet are calculated on the basis of the cost of diets at different dietary levels as set up by nutrition experts. The three scales of the U. S. study of the expenditures of wage earners and clerical workers (referred to subsequently as the U. S. Wage Earner Study) are of special interest as illustrating the effects on a food scale of changing prices over a period of two years.[9]

The outstanding difference between the later and the earlier scales is the increased values assigned to children. This doubtless reflects the change in food habits in accordance with the modern tendency towards an increase in provision of the relatively more expensive protective foods in the diet, especially for children.

In Table II specific scales are presented for clothing, rent, "other items," and "all items except food."

In addition to those shown, a series of detailed scales were developed by Kirkpatrick for farm families, for food, clothing, rent, furnishings, household operation, health maintenance, advancement, personal goods and insurance; in these the ratings were based not solely on age and sex but in some cases on size of family, of number of children in the household, or similar points of family composition.[10]

In Table III, four all-items expenditure scales are shown, including two which antedate the Sydenstricker-King scale, and one, based on

[9] "The scale of food expenditure units was based on data secured from the Bureau of Home Economics showing quantities of food consumed by persons of different age, sex and physical activity, estimated partly on the basis of energy requirements and partly on the basis of actual food consumption of families of wage earners and clerical workers." Faith M. Williams and Alice C. Hanson, *Money Disbursements of Wage Earners and Clerical Workers 1934–36*. Summary Volume, U. S. Bureau of Labor Statistics, Bull. No. 638, p. 50, note 9.

[10] Evelyn G. Tough and E. L. Kirkpatrick, "Scales for Measuring the Standard of Living." this Journal, Vol. 28, No. 181, March 1933, pp. 55–63. See also E. L. Kirkpatrick, "The Standard of Life in a Typical Section of Diversified Farming," Cornell University Agricultural Experiment Station Bull. 423, and "The Relation of the Ability to Pay to the Standard of Living," U. S. Department of Agriculture Bull. 1382.

The food scale distinguishes between the first person in each sex and age group and additional persons: for the first person—children under 6, .3; 6–11, .4; 12–14, .6; males 15–18, .8; males 19 and over 1.0; females 15–18, .7; females 19 and over .9, For additional persons, the scale rating is the same as that shown diminished by 0.1 point.

The clothing scale is as follows: operator 1.0; home maker 1.0; other persons: 1–5 years, 0.4; 6–11, .6; 12–14, 1.0; 15–18, 1.3; 19–24, 1.7; over 24, 1.4.

The rent scale: operator 1.0; homemaker 1.0; other persons: 15 years of age and over, males: first .2, second 0, third .2, fourth 0, etc.; females: first .2, second 0, third .2, fourth 0, etc.; 6–14 years of age, males: first .1, second 0, third .1, fourth 0, etc.; females: first .1, second 0, third .1, fourth 0, etc. Under 6 years of age 0.

The furnishings scale (also used for household operation, and for life and health insurance): operator 1.0; homemaker 1.0; other persons regardless of age: first .4; second .3; third .2; fourth .1; additional 0.

Maintenance of health scale: operator 1.0; homemaker 1.0; children under 6 years, .6; 6–24 years, .2, over 24, .4.

Advancement scales, operator 1.0, homemaker 1.0; children under 6, 0; 6–14, .1; 15–18, .3; over 19, .5.

Personal goods scale: operator 1.0, homemaker .6; children: under 6, .2; male 6–14, .4; 15–18, .5, 19 and over 1.0; female, 6–14, .3; 15–18, .5; 19 and over, .6. Tough and Kirkpatrick, *op. cit.*, p. 57–58.

TABLE II

EXPENDITURE SCALES FOR ITEMS OTHER THAN FOOD*

Age	Clothing		Rent and housing		All specific items		All items except food	
	U. S. Wage Earner Study†		Bowley§		Sydenstricker and King¶		Germany††	
	M	F	M	F	M	F	M	F
Under 1 Year	0.19	0.19	0.25	0.25	0.11	0.11	0.20	
1	.19	.19	.25	.25	.13	.13	.20	
2	.34	.38	.25	.25	.16	.16	.20	
3	.34	.38	.25	.25	.17	.17	.20	
4	.34	.38	.25	.25	.19	.18	.20	
5	.34	.38	.50	.50	.20	.19	.20	
6	.48	.47	.50	.50	.22	.21	.30	
7	.48	.47	.50	.50	.24	.23	.30	
8	.48	.47	.50	.50	.26	.25	.30	
9	.53	.56	.50	.50	.28	.27	.30	
10	.53	.56	.50	.50	.31	.30	.50	
11	.53	.56	.50	.50	.33	.33	.50	
12	.63	.77	.50	.50	.35	.37	.50	
13	.63	.77	.50	.50	.40	.40	.50	
14	.63	.77	.75	.75	.46	.44	.50	
15	.88	1.01	.75	.75	.55	.48	.70	
16	.88	1.01	.75	1.00	.65	.57	.70	
17	.88	1.01	.75	1.00	.77	.60	.70	
18	1.01	1.28	1.00	1.00	.86	.61	.70	
19	1.01	1.28	1.00	1.00	.92	.63	.70	
20	1.01	1.28	1.00	1.00	.95	.63	1.00	.90
21 +	‡	‡	1.00	1.00	**	**	1.00	.90

* Unless otherwise noted, the last figures given apply also to higher ages.

† Faith M. Williams and Alice C. Hanson, *Money Disbursements of Wage Earners and Clerical Workers 1934–36*. Summary Volume. U. S. Bureau of Labor Statistics Bulletin No. 638, pp. 364.

‡ Males: for ages 15–20 the figures given above are for "at school": for ages over 15 figures are given also for groups "at home," "clerical," and "wage earners." The wage earner figures are: 15–18, 1.02; 18–21, 1.13; 21–24, 1.07; 24–27, 1.00; 27–30, .96; 30–36, .92; 36–42, .87; 42–48, .81; 48–54, .75; 54–60, .69; and 60 and over, .60. Females: for ages 15–20 the figures given above are for "at home." For ages over 15 figures are given also for groups "at home," "clerical" and "wage earner." The wage earner figures are: 15–18, 1.08; 18–21, 1.63; 21–24, 1.60; 24–27, 1.46; 27–30, 1.36; 30–36, 1.23; 36–42, 1.07; 42–48, .94; 48–54, .84; 54–60, .76; over 60, .67.

§ See Faith M. Williams and Carle C. Zimmerman, *Studies of Family Living in the United States and Other Countries: An Analysis of Material and Method.* U. S. Dept. of Agriculture, Misc. Publ. No. 223, p. 56.

¶ Edgar Sydenstricker, and W. I. King, "The Measurement of the Relative Economic Status of Families" *Quarterly Publication of the American Statistical Association*, Vol. 17, No. 135. Sept. 1921, p. 853. The expenditures thus covered exclude rent and similar undistributable items as well as food.

** Figures are given in the source for each age up to 80, for which the ratings are .43 and .25 for male and female respectively. The unit figure of 1.00 is for males at age 25.

†† Germany, Statistisches Reichsamt. "Die Lebenshaltung von 2,000 Arbeiter-, Angestellten-, und Beamtenhaushaltungen," *Einzelschriften zur Statistik des Deutschen Reiches*, No. 22, Berlin, 1932.

the writer's estimate for the U. S. Wage Earner Study, which is subsequent to it.

The paucity of all-items scales is in marked contrast to the relative abundance of new food expenditure scales; the latter reflect the increased attention being paid to diets and parallels the development of

specific scales for different nutrients. Where income or expenditure levels are needed in connection with food studies, recent practice has preferred a specific classification based on food expenditure per food expenditure unit, in place of the general classification per general expenditure unit.

An important reason for the paucity of all-items scales on the same level of technical elaboration as those for food and clothing is the tendency observed in a number of recent studies to calculate the number of consumption units in each family, not from the sex and age composition in conjunction with an all-items scale, but as a weighted harmonic average of the number of specific food-expenditure units, clothing-expenditure units and other-items-expenditure units following the procedure first suggested by Kirkpatrick[11] in 1921–22. This method was followed also, for example, in the U. S. Wage Earner Study of 1934–36.[12]

This technique suggests two important points. First, that all-items scales can be constructed by weighting specific scales for the component elements of the budget as well as by a direct technique. Secondly, this draws attention immediately to the inequality of coverage of the different elements of the budget: food and clothing are relatively well covered, but rent and miscellaneous items almost not at all. If these latter enter into the final all-items scale with a weight of approximately 50 per cent, the inadequacy of coverage is serious. To these difficulties must be added the further fact that the determination of scale values in the case of expenditures which are family rather than individual in character, such as rent, household expenditures and certain miscellaneous items may involve arbitrary judgments or exclusions.

[11] Evelyn G. Tough and E. L. Kirkpatrick, "Scales for Measuring the Standard of Living," this JOURNAL, Vol. 28, No. 181, March 1933, p. 57.

In the calculation the food expenditure per food unit, the clothing expenditure per clothing unit, and other expenditures per other-items unit are added together to give expenditure per "cost-consumption" unit, and this figure divided into the total expenditure of the family gives the number of "cost-consumption" units in the family.

In practice the cost-consumption unit method is somewhat more flexible since in determining the number of units in one or more of the subgroups, the number of persons in the family may be utilised instead of sex and age data.

[12] Faith M. Williams and Alice C. Hanson, *Money Disbursements of Wage Earners and Clerical Workers 1934–36*. Summary Volume. U. S. Bureau of Labor Statistics Bull. No. 638, pp. 362–366. In the Table, the last column represents an estimated average of the food, clothing, and "all-other" items scales (estimated by the writer): the number of units in each family for "all other" items being placed, as stated in the study, equal to the number of "equivalent full-time persons in the economic family." A weighted average varying with the expenditures of each family, but not a harmonic average, was utilised in the German study of 1927; the number of consumption units in each household was calculated as the weighted average of the number of food units and the number of "other items" units, the weights being the amounts expended in each household upon food and other items respectively. Germany. Statistisches Reichsamt. "Die Lebenshaltung von 2,000 Arbeiter-, Angestellten-, and Beamtenhaushaltungen," *Einzelschriften zur Statistik des Deutschen Reiches*, No. 22, Berlin 1932, Vol. I, pp. 11–12, and esp. p. 238.

TABLE III
GENERAL EXPENDITURE (ALL ITEMS) SCALES*

Age	Engel† (1895)		Germany‡ Stockholm (1907–08)		Sydenstricker and King§ (1917)		U. S. Wage Earner Study** (estimated)	
	M	F	M	F	M	F	M	F
Under 1 year	0.29		0.10		0.22		0.74	
1	.31		.10		.24		.74	
2	.34		.10		.28		.75	.77
3	.37		.10		.31		.75	.77
4	.40		.20		.33		.79	.79
5	.43		.20		.35		.79	.79
6	.46		.20		.38		.80	.80
7	.49		.30		.40		.86	.80
8	.51		.30		.42	.41	.86	.86
9	.54		.30		.44	.43	.89	.87
10	.57		.40		.47	.45	.89	.87
11	.60		.40		.50	.48	.91	.90
12	.63		.40		.54	.51	.93	.92
13	.66		.50		.59	.55	.96	.92
14	.69		.50		.66	.60	.96	.94
15	.71		.70	.60	.74	.65	.99	.97
16	.74		.70	.60	.81	.71	.99	.97
17	.77		.90	.70	.88	.74	.99	.97
18	.80		.90	.70	.93	.76	1.01	.97
19	.83		1.00	.80	.96	.78	1.01	.97
20	.86				.98	.78	1.00	.94
21	.89	.86			.99	.79		
22	.91	.86			.99	.79		
23	.94	.86			1.00	.79		
24	.97	.86			1.00	.79		
25 and over	1.00	.86			¶			

* Unless otherwise noted, the last figures shown apply also to higher ages.

† The "quet" scale transferred to the adult male 25 and over as unity. E. Engel, Die Lebenshaltung belgischer Arbeiterfamilien, früher und jetzt. *Bull. Internat. de Statistique*, Vol. IX, 1ère livraison, 1895, p. 5.

‡ Germany. Statistisches Reichsamt. Abteilung für Arbeiter-statistik. Wirtschaftsrechnungen minder-bemittelter Familien im Deutschen Reich. Sonderheft zum *Reichsarbeitsblatt*, 1909. Galle: Stockholmer Wirtschaftsrechnungen (1907–1908), *Jahrbuch für Nationalökonomie und Statistik*, 1911, Vol. 96 (Third Series Vol. 41), p. 368.

§ Edgar Sydenstricker and Willford I. King. "The Measurement of the Relative Economic Status of Families," *Quarterly Publication of the American Statistical Association*, Vol. XVII, No. 135, Sept. 1921, p. 854.

¶ For ages over 25, the scales are: Males: 25–26: 1.00; 27: .99; 28–29: .98; 30–31: .97; 32–33: .96; 34–35: .95; 36–38: .94; 39–42: .93; 43–45: .92; 46–47: .91; 48–49: .90; 50–51: .89; 52: .88; 53: .87; 54: .86; 55: .85; 56: .84; 57–58: .83; .59: .82; 60–61: .81; 62–63: .80; 64–65: .79; 66–68: .78; 69–70: .77; 71–73: .76; 74–78: .75; 80: .74; Females: 25: .79; 26–30: .78; 31–33: .77; 34–36: .76; 37–38: .75; 39–41: .74; 42–43: .73; 44–45: .72; 46–47: .71; 48–49: .70; 50–52: .69; 53–54: .68; 55–57: .67; 58–60: .66; 61–64: .65; 65–67: .64; 68–73: .63; 74–80: .62.

** Estimated by the author as a weighted average of scales for food, for clothing and for "all other items," the latter being given a scale rating of 1.00 at all ages: the weights used were 3, 1, and 5 respectively for food, clothing and all other items. No all-items scale is given in the report; the method used in the study was to calculate the number of expenditure units in each family by dividing the total amount of expenditure by the sum of (1) the food expenditure per food expenditure unit, (2) clothing expenditure per clothing expenditure unit, and (3) other expenditures divided by the number of equivalent full-time persons in the economic family. See Faith M. Williams and Alice C. Hanson, *Money Disbursements of Wage Earners and Clerical Workers, 1934–36*. Summary Volume. U. S. Bureau of Labor Statistics Bulletin No. 638, pp. 363–366.

A second reason for the relative lack of all-items scales lies in the technical difficulties of preparing a new all-items scale in time for use in analyzing the data of the study on which it is based. The delays involved in a complete preliminary analysis of the data, to construct a scale adapted to the material of the study before any other analysis is undertaken, are often regarded as prohibitive in view of the pressure under which large scale investigations are conducted.

Finally, the adoption of the classification according to family type has led to a somewhat lessened emphasis upon all-items scales.[18] The latter have served various purposes, one of which has been to express in numerical relation the demand for consumption goods represented by different family members or additions to the family. But the demand for consumption goods represented by infants or very young children, for example, in families of man, wife and one child can be studied more closely and the results presented more convincingly by an analysis in which families of this type are segregated for examination than by a technique which merely adds their consumption unit value to that of other family members in all types of families. It follows, however, that in the analysis by family type each type group is studied separately, and no attempt is made to summarize or cumulate the results.

When the mass of material permits, detailed study of habits of consumption and expenditure can be made for each important family type; the types chosen are, for example, families with two adults only, families with man, wife and one child, families with man, wife and two to four children, families with man, wife and five or more children, etc. Obviously the significance of the analysis depends in part upon the specific character of the family types: if, for example, light is desired upon the character of the expenditures resulting from the addition of a baby or infant to a family of two, the families studied should be limited to those cases of families of man, wife and one child in which the child is under the age of one or two years. Obviously, also with the greater degree of specificity in the families selected for study, a larger total mass of materials is required to yield a sufficient volume for the detailed groups.

When a cumulative result is required, therefore, as in combining all the data of a study according to economic status groups, the use of a consumption scale is still needed. Also where additional attention needs to be paid to age differences or to the number of individuals of a particular age class, for example, young children, in the analysis of family

[18] In the U. S. Consumer Purchases Study, the analysis according to all-items expenditure units was dropped.

type groups, the consumption unit technique is helpful in addition to the classification according to family type.[14]

Two other points deserve attention. None of the scales as thus developed attempts to differentiate in scale values between different income levels. As to such differences Sydenstricker and King stated that for the families in their survey "differences in income did not seem radically to affect the character of the scales," but admitted that their materials included "too few families of high income to afford an adequate basis for definite conclusions."[15] The procedure mentioned above —of calculating the number of consumption units in each family by weighting by the relative expenditures in that family on food, clothing, and other items—takes this difference in income levels into account in part, so far as differences in proportionate expenditure on food and miscellaneous do accompany differences in income levels: on the other hand no separate scales for the different income levels are applied.

The second point concerns the proliferation of specific economic scales in terms of conceptual schemata of consumption as well as of actual habits. In addition to scales derived from the data of actual consumption of specific population groups studied by the usual statistical techniques, scales may be developed on the basis of estimated "requirements" as to food, clothing, medical services or social-economic "standards" of living. Sydenstricker and King dealt with the former method. Either type of scale can be used to differentiate a population into groups according to income per unit. The latter can be utilized to compare the actual expenditures of families for food, for example, with the expenditures required for a given level of food consumption, thus making possible a conclusion in regard to the sufficiency of food expenditures to maintain an adequate diet. Such a comparison is in any case, a poor substitute for sound nutrition analysis on the basis of foods actually consumed. The distinction between the two methods is perhaps less than appears at first sight: both are for definite "specifications," in one case defined in terms of customary habits of a particular group and determined by statistical techniques, in the other defined in terms of "desirable" or standard "requirements" and determined by experts or on the basis of a consensus of opinion. In any case, the difference in the cost per unit (the adult male)—of customary consumption or of "requirements"—is of course large and important; but the differences in scales representing the relative costs for persons of different age and sex

[14] Allen reaches the conclusion that the family type analysis is more important than the consumption unit analysis. See R. G. D. Allen, "Expenditure Patterns of Families of Different Types," in *Studies in Mathematical Economics and Econometrics*, in Memory of Henry Schultz. (Ed. by Oscar Lange, Francis McIntyre, and Theodore O. Yntema) pp. 190–207, esp. 200–202.

[15] *Op. cit.*, p. 855.

to that of the adult male, are relatively minor, though doubtless ample to justify the adoption of the best scale in place of one poorly adapted to the needs of the particular problem.

As to the future, three lines of development of economic scales may be emphasized: possibilities of analysis of levels of living by means of specific scales, increased attention to direct uses of economic scales, and application of scales to international comparisons.

The development of specific scales for food expenditure, clothing expenditure, etc., in conjunction with all-items scales, in terms of specifications for different levels of living, makes possible a breakdown of the concept of the general level of living into its component parts. Thus, for example, if different levels of food consumption are designated by the letters A, B, C, D, etc., each defined in terms of food expenditure per food unit, and clothing levels are similarly defined in terms of clothing expenditure per clothing unit, etc., it becomes possible to describe the habits of families at different levels of general expenditure in terms of the levels of the several components. The level of living of a family then becomes a group of levels, for food consumption, for clothing, for rent, etc. With the aid of these specific levels of expenditure on specific items, in comparison with the concrete elements of food consumption, for example, different degrees of efficiency of consumption, waste, etc., may be distinguished.[16]

Secondly, the use of economic scales in direct applications is increasing. For example, the scale values of food costs for each year of age in conjunction with the food cost of the adult male[17] were utilized in a recent estimate of the cost of feeding a child from birth to 18 years of age. Obviously, such an estimate depends for its accuracy upon the accuracy of the individual scale values for each sex and age in the food expenditure scale. Similarly, estimates of the total cost of food, clothing, or other items of expense, or of all items in the cost of living for families, groups or the total population of a community may be made by means of scale values in conjunction with the costs for the adult male unit; and as a corollary, the amounts required to raise families, groups or the total population up to a particular level of living, e.g., the relief level, may be estimated.[18]

[16] As an example of this type of analysis, the correlation of the grade of diet with food expenditure per food unit may be cited. See Hasel K. Stiebeling, "The Dietary Situation in the United States." In *Proceedings*, National Nutrition Conference for Defense, May 26, 27, 28, 1941. Washington, D.C., pp. 82–87.

[17] See "The Cost of Feeding a Growing Child," *Statistical Bulletin* (Metropolitan Life Insurance Company). Vol. 24, No. 9, September 1943, pp. 7–9.

[18] This technique as applied to relief may be viewed as an extension of that used in the relief of dependent families in the Chicago Standard Budget, a procedure which embodied implicitly a set of scale values. See F. Nesbitt, *The Chicago Standard Budget for Dependent Families.*

An important application of economic scales is to estimate requirements in monetary terms for the relief of populations, for example, of the occupied countries of Europe. The cost of feeding and clothing the population in liberated areas may be estimated on the basis of the sex and age distribution of the population, in conjunction with the costs of feeding and clothing persons of different sex and age. Or the cost of maintaining a population at the relief level may be estimated by applying to sex and age composition the cost of relief for persons of different sex and age as embodied in a consumption scale at the relief level. Theoretically, this requires a scale which is based upon local consumption data[19] and which takes into account the specific level of the relief operation.

This raises questions of the applicability of scales to different places, and thus leads to the consideration of the problem of international standardization and international comparisons.

The problem of international comparisons may be envisaged in terms of determining the cost of maintaining different population groups at the same level of living in different places. This involves three elements: the problem of determining the equivalence of the commodity and service elements of the standard in different places, the cost of maintaining the adult male at the given level in each place, and the relative costs of persons of different sex and age in terms of the adult male, that is, the scale valid for each place.

If the level of living is defined in broad terms as the "poverty line," the "health and decency" level, the "comfort" level, etc., the basic problem for international comparisons is to draw up the lists of goods and services, in specific amounts, which represent, for the adult male, the desired level in each of the communities for which estimates are sought. In concrete terms, having defined the "poverty line" in York, England, in terms of a standard set of commodities, what changes would be required to make it applicable, for example, to Chicago, Illinois, or Geneva, Switzerland? In each place the cost of the set of commodities which define the particular standard for the adult male can be ascertained according to local prices. Similarly, the relative scale values for persons of different sex and age in terms of the adult male can be determined under the conditions set by the local components of the standard and local prices. With these elements, it becomes possible to estimate (a) the number of consumption units in a local population, (b) the total cost for the particular population of maintaining the given standard,

[19] Also local price data, if relief is to be operated through local markets.

and (c) the cost of maintaining populations in different places at the same standard.

This statement indicates the solution of the problem of comparability of economic scales for purposes of international comparisons. The scales themselves may not be strictly uniform (though, in practice, they may be closely similar); but the final results in terms of costs of a particular level of living should be theoretically comparable. The value of the results depends upon validity of the scales each for its local community and local prices as well as upon the validity of the methods adopted for determining the component goods and services in different places so that they represent the same level of living; since errors in the scale enter directly in the final result, the scales must, of course, be as accurate as possible.

This brief statement doubtless passes over too lightly the difficult problems involved in criteria for establishing equivalent levels of living in different places. An entire literature has grown up around this topic.[20] Special methods and new techniques may be required before a satisfactory solution is reached.

The problem of standardization may be approached also in the light of the similar movement in the case of nutrition scales. Standardization is applied to the specific scale. The specificity characteristic of nutrition scales has its counterpart in economic scales but with differences: first, the specific economic scales for food, clothing, etc., do not exclude the all-items scale where money values are used to equate the demand for different items of expenditure; and secondly, the economic scales are specific to habits of expenditure,[21] to local price structure, and to the particular level of living. The standardization of economic scales therefore must resolve the problems inherent in differences in these specific characters, either by demonstrating that the differences are of no substantial importance, or by reaching a basis of comparison on equivalent levels of living where local habits and local prices are taken into account. Secondly, the nutrition scales to be standardized are standardized on the basis of requirements. Economic scales of autogenous character applicable only to a particular study offer no possibility of

[20] Cf., for example, International Labour Office: "A Contribution to the Study of International Comparisons of Cost of Living," *Studies and Reports Series N.*, No. 17 (Geneva, 1932); also, Robert Morse Woodbury, "International Comparisons of Food Costs," International Labour Office, *Studies and Report Series N.*, No. 24, esp. pp. 34–35, 61–63.

[21] The habits of expenditure may be "customary" and characteristic of a particular level of living, or conceptual as constituting a set of expenditures which will meet, in the judgment of experts, the minimum "requirements" for living at a level, for example, of adequate food consumption, maintenance of health, satisfactory clothing standards, etc. Obviously the techniques for establishing these so-called "requirement" scales are different from those for establishing scales based upon customary habits.

standardization: economic scales can be standardized only on the basis of common "specifications" for a particular level of living, where the term "specifications" for a socio-economic level of living corresponds to the physiological "requirements" for a level of nutrition. Thirdly, standardization is particularly useful where the scales are applied in direct uses, such as those illustrated in the preceding paragraphs; but when they are applied indirectly, as in the case of income per consumption unit, the difficulties are greater and the advantages less; hence, the growing importance of these direct applications increases the need for such standardization.

In conclusion, the twenty years since Sydenstricker and King's paper have seen a marked development of food expenditure scales and modest additions to the group of other specific scales. In all-items scales, however, comparatively little advance has been made, owing in part to the growing reliance upon an approximate method of analysis per capita (or per consumption unit according to any of the standard scales) as sufficiently good for the indirect uses to which these scales have been mainly applied. In fact for these indirect uses there is much to be said in favor of adopting the per capita basis of calculation, since it has the advantage of being easily comprehended and in comparisons with other studies complications arising from differences in scale values are avoided. But with increased attention to direct uses of economic scales, as in estimates of international relief costs, we may expect important developments in these scales and in particular a movement toward international standardization as the problems involved in comparing standards of living in different places reach a satisfactory solution.

THE DISTRIBUTION OF PRIVATE, NON-AGRICULTURAL EMPLOYEES IN THE UNITED STATES BY STRAIGHT-TIME HOURLY WAGE RATES*

BY DAVID R. ROBERTS

UNTIL A FEW MONTHS ago a comprehensive frequency distribution of employees by hourly wage rates could have been constructed only by sheer guess work. Recently sample data have become available from which the distribution which appears as Table II was constructed. The data are satisfactory for the areas and lines of business covered but they constitute a very limited sample. Therefore, in using them, it was necessary to make a number of assumptions, and accordingly more than usual interest attaches to a description of the techniques employed. Since the procedures varied from one field of business to another they will be elaborated along industry lines.

Before commencing a description of techniques, however, the precise coverage of the distribution will be indicated. Table I shows the magnitude of the civilian labor force, the groups excluded from the study and the balance of employees who are covered. Governmental employees were excluded because the data are inadequate and what figures are

TABLE I

BREAKDOWN OF CIVILIAN LABOR FORCE, JANUARY 1944

(in millions of employees)

Civilian labor force		51.4
Deduct:		
Unemployed	1.1	
Agricultural	6.6	
Governmental	5.6	
Own account	2.6	
Employers	1.9	
Unpaid family workers	.4	18.2
Private non-agricultural employees		33.2
Deduct:		
Non-wage earning employees† in manufacturing	2.3	
Non-wage earning employees† in mining	.2	
Non-wage earning employees† in construction	.1	
Domestic servants	1.6	
Professionals	1.3	5.5
Private non-agricultural employees included in Table II		27.7

† This category consists of clerical, technical and supervisory employees.

* This study is a revision of one made in the spring of 1944 for the National War Labor Board, Wage Stabilization Division, Research and Statistics Branch. Since that time more refined techniques have been applied to the basic data with the result that the figures presented here differ in some details from those in the original War Labor Board report.

available are in monthly or annual terms and cannot be combined with the hourly data secured for the other categories. Similar considerations apply to agricultural employees. Clerical, technical and supervisory workers were excluded in specified industries because data were unavailable. The same consideration dictated the exclusion of domestic servants. In the case of professionals limited data are available but they are in monthly or annual terms and are three years old.

The manufacturing distribution is based on a distribution as of June 1943 prepared by Messrs. R. J. Myers and H. D. Bloch of the Bureau of Labor Statistics and published in the October 1943 issue of the *Monthly Labor Review*. These investigators did not make an original survey in June 1943; they took over, as raw materials for their study, fifty-eight distributions of particular manufacturing industries which had been compiled and published by the Bureau between 1939 and 1942. The industries surveyed were taken to typify the major industry groups in which they fell. The original distributions were accordingly brought up to date, inflated to the total employment in the respective major industry groups, and then combined into a single distribution for all manufacturing. In general, the adjustment procedure employed was to split each original distribution into 1-cent class intervals. In these cases the lower limits of the intervals were multiplied by the ratio of average straight-time hourly earnings in the appropriate industry group in June 1943 to average straight-time hourly earnings in the same industry group on the date of the survey, and the frequencies were then regrouped into 10-cent intervals. In some instances other adjustments were made, e.g., to give effect to a minimum wage imposed on a particular industry since the survey date under the Fair Labor Standards Act.[1] The Myers-Bloch distribution was brought up to January 1944 by a method similar to that by which it had been brought up to June 1943, and it was then adjusted to the total number of manufacturing wage earners in January 1944.

Except for the effect given to changes in minimum wage laws, which was significant in a few lines, the foregoing procedure amounts to constructing new distributions such that their arithmetic means and ranges[2] shall be X per cent of those of the old distributions and such that their skewness shall be the same as that obtaining in the old distributions. Changes in skewness are highly important in wage distribu-

[1] For a further elaboration of the technique consult *Monthly Labor Review*, October 1943, "The Level of Factory Wage Rates in Wartime" and *Monthly Labor Review*, June 1942, "Distribution of Factory Workers by Hourly and Weekly Earnings."

[2] The new range need not be precisely X per cent of the old but it will closely approximate that figure.

TABLE II

ESTIMATED FREQUENCY DISTRIBUTION OF PRIVATE, NON-AGRICULTURAL EMPLOYEES* BY STRAIGHT-TIME WAGE RATES† AS OF JANUARY 1944

(in thousands of employees)

Hourly rate	Manufacturing	Mining	Construction	Transportation, communition & public utilities	Retail trade	Wholesale trade	Finance, insurance & real estate	Services	Grand total	Per cent	Per cent cumulative	Hourly rate
Under 20 cents‡	—	—	—	—	16	—	—	79	95	.3	.3	Under 20 cents‡
20 & under 30	—	—	—	—	260	1	—	215	476	1.7	2.0	20 & under 30
30 " " 40	122	—	—	26	1,002	21	12	388	1,571	5.6	7.6	30 " " 40
40 " " 50	965	4	8	108	1,336	155	136	371	3,083	11.1	18.7	40 " " 50
50 " " 60	1,461	9	44	630	783	108	255	159	3,449	12.4	31.1	50 " " 60
60 " " 70	1,479	10	50	383	496	172	275	125	2,990	10.7	41.8	60 " " 70
70 " " 80	1,561	13	44	410	314	217	151	96	2,806	10.1	51.9	70 " " 80
80 " " 90	1,691	36	24	627	238	167	53	147	2,983	10.7	62.6	80 " " 90
90 " " 100	1,585	84	25	396	95	161	65	67	2,478	8.9	71.5	90 " " 100
100 " 110	1,291	74	48	593	50	136	97	62	2,351	8.5	80.0	100 " " 110
110 " " 120	1,017	152	29	160	35	101	69	75	1,638	5.9	85.9	110 " " 120
120 " " 130	890	112	56	92	23	98	29	18	1,318	4.7	90.6	120 " " 130
130 " " 140	672	57	34	39	14	101	3‡‡	16	936	3.3	93.9	130 " " 140
140 " " 150	384	27	16	48	11	45		17	548	2.0	95.9	140 " " 150
150 " " 160	538§	3	73	71	5	30		2	988§§	4.1§§	100.0	150 " " 160
160 " " 170			40	58	4	23		9				160 " " 170
170 " " 180			49		3	29††		6				170 " " 180
180 " " 190			8		2			5				180 " " 190
190 " " 200			6		1**			5				190 " " 200
200 " " 210			8					—				200 " " 210
210 " over			4¶					6				210 " over
TOTALS	13,656	581	566	3,641	4,688	1,565	1,145	1,868	27,710	100.0		TOTALS

* The distribution excludes agricultural and governmental employees, professionals and domestic servants. All employees are included except in manufacturing, mining and construction; in these cases only wage earners are included.

† The mining distribution is gross average hourly earnings; all others are straight-time hourly rates.

‡ Most of the observations in this interval lie close to its upper limit.

§ Includes all persons over $1.50.

¶ Includes all persons over $2.10.

** Includes all persons over $1.90.

†† Includes all persons over $1.70.

‡‡ Includes all persons over $1.30.

§§ Includes all persons over $1.50.

tions because they indicate shifts of workers from low to high positions in the wage scale or vice versa. Therefore, it should be kept in mind that the component distributions of the manufacturing distribution are restricted by the skewness obtaining in their lines during the period 1939–1942.

However, that restriction is not as damaging in this case as it might be in another. The shape of a composite distribution like that for manufacturing depends upon (a) the shape of the constituent distributions and (b) the weights assigned to them. Due to the fact that there is much variation in shape from industry to industry, changes in weighting are likely to be a more important determinant of the shape of the composite distribution than any likely short-run changes in the shapes of the constituent distributions. The weights used were the number of wage earners employed in the various major industry groups on the dates considered. Inasmuch as these data are quite reliable, the manufacturing distribution is likely to give a fairly good representation of the wage structure despite the restriction which has been noted with respect to the skewness of the constituent distributions.

Furthermore that restriction is not a very serious one. The shapes of the constituent distributions result from the occupational differentials within the industries and from the distribution of employees among the several occupations. The short-run rigidity of the structure of occupational differentials and the unlikelihood in the short-run of violent technological changes which would permit a new occupational distribution of employees tend toward a short-run perpetuation of whatever shape a wage distribution may have.

Opposing these basic resistances to changes are certain factors which tend to modify occupational differentials and the distribution of employees; the balance, during any period of time, of these factors against the basic resistances determines the extent to which a distribution changes. The most important factors which have operated to change the wage structure since 1939 are (1) general percentage and cents-per-hour increases which operate on the occupational differentials, and (2) the upgrading of old employees to different, higher paid jobs and the influx of new workers into the low-end jobs as industry expanded, which changes influence the occupational distribution of employees. A general percentage increase raises the arithmetic mean and the range but does not affect the skewness of the distribution. A general cents-per-hour increase shifts the curve bodily to the right; its range and skewness are unchanged but its arithmetic mean rises. The upgrading of old employees skews the curve to the left, i.e., diminishes the frequencies in the low

intervals and raises them in the high intervals. The arithmetic mean rises but the range is unaffected. The influx of new workers into the low-end jobs increases the frequencies in the low intervals, thereby lowering the mean and skewing the curve to the right, but not altering the range.

Most general increases in recent years have been on a cents-per-hour rather than a percentage basis. Consequently, the Myers-Bloch method, which is satisfactory for percentage changes, has probably distorted the distribution somewhat. It is difficult to determine how great a distortion has been introduced. Both types of general increase raise the mean and leave the skewness unchanged. The difference between them is that the range is increased in the case of a percentage increase and is not increased in case of a cents-per-hour increase. Therefore, the Myers-Bloch method which conforms to the percentage increase would spread the total frequency over too wide a range. Which intervals it has over- and under-loaded depends upon the relative magnitude of the equivalent cents and percentage increases. In a few cases where both methods have been employed, they have not led to widely divergent results. To the extent that this relationship prevails, the distribution, as presented, is valid as to changes affecting occupational differentials.

The components of the second category of factors, those which affect the occupational distribution of employees, operate in opposite directions: the first shifts the frequency from the low to the high intervals and the second increases the frequencies in the low intervals. If these movements occur simultaneously, as they have, they tend to offset one another and to leave the shape of the distribution unchanged; if they occur singly they must soon peter out, barring technological change, because of inability to utilize a disproportionate number of workers in any category. From now on, one would expect the second component to operate weakly because manufacturing employment appears to have reached its peak. However, in the period 1939 to 1944 there was a large increase in employment as well as much shifting to high-paid jobs. Therefore, the presumption is that the net effect of these two components of the second factor of change is not large and that the distribution, as presented, is valid as to changes in the occupational distribution of employees. Accordingly, it is likely that the manufacturing distribution presented is a tolerable approximation of the true distribution.

The mining distribution is based upon all mine payroll reports for January 1944 made to the Bureau of Labor Statistics and covers 372,-400 employees in all branches of the industry. The class frequencies

were inflated to a total of 581,000, the number of wage earners in the industry in January 1944. Each reporting mine submits the total amount of its pay roll and the total man-hours worked. The first was divided by the second to secure the hourly figures from which the distribution was constructed. Consequently, the data include overtime pay which makes them gross average hourly earnings rather than rates. Also the distribution is not one of individual employee earnings but rather is one of plant averages of individual employee earnings. The consequence is that the range of the distribution is narrower than the true range and that the concentration of frequency is too great.

The distribution of construction workers was derived as follows: A 15 per cent sample was taken of federal government contractors. (These are required to file payrolls with BLS.) The sample was distributed geographically and with respect to types of construction by drawing it regionally as 15 per cent of contractors in each major type of construction. About 35,000 employees were covered and this sample was inflated to the total number of construction wage earners. The weakness in this procedure is that rates vary with the type of construction. The method employed imputes to all construction the same distribution by types which prevails for federal construction. However, since federal construction is a little more than half the total, and since average hourly earnings are close to federal and to those types of non-federal construction for which the data are available, the error involved is probably not great.

The railway distribution is based on data for January 1944 issued by the Interstate Commerce Commission. These data cover all employees of Class I steam railways,[8] and are presented in the form of straight-time hours and payrolls for each occupation. The latter were divided by the former to secure the hourly earnings figures from which the distribution was constructed. Inasmuch as the hourly earnings figures used are occupational averages, the range of the distribution is narrower than the true range and the frequency is too highly concentrated as in the case of the mining distribution where plant averages were used. The latter obliterates dispersion due to occupational differences and the former obliterates dispersion due to regional and individual differences.

The telephone distribution covers the Bell System Companies which constitute over 90 per cent of the industry. The data were compiled by the Federal Communications Commission and appear in "Statistics of the Communications Industry in the U. S."—1943. As tabulated by the

[8] Officers and a few categories of supervisory and technical employees, whose compensation was quoted by the day, were omitted from the distribution.

F.C.C., the distribution was in terms of weekly wages with class intervals which became progressively wider. Reduced to an hourly basis, the intervals became so wide above 60 cents per hour that it was necessary to break them up. The frequency was distributed in such a way as to smooth the descent of a curve which would otherwise have gone down in a step formation. The sum of the telephone and railway distributions was inflated by the factor of 2.28 to the total employment in the transportation, communication and public utility industries.

In the fields of retail and wholesale trade, finance and services, no comprehensive wage data have ever been gathered; in fact, until recently, there have not even been sample data. In April 1943 the BLS began to make Occupational Wage Rate studies of certain non-manufacturing industries, and frequency distributions have been built up from these data.[4] The use of some 1943 data imparts a downward bias to the distribution because, according to a recent BLS study, "Wartime Wage Movements and Urban Wage Rate Changes," rates rose from April 1943 to April 1944 by about 12 per cent in retail trade, 4 per cent in wholesale trade and 7 per cent in finance. However, an upward bias is introduced by the fact that in general the communities surveyed were the larger ones, where wage rates tend to be higher than in small towns. In the case of each industry included in the BLS studies, surveys were made in selected communities. These reports list, for a particular community, the number of people engaged in each important occupation of the industry in question together with their average hourly rates.[5] Within the communities surveyed, the coverage is frequently above 90 per cent and in no case examined did it fall below 60 per cent.

The coverage with respect to communities and lines of business is spotty.[6] Some lines are covered in one region and not in another. In some regions, few communities have been surveyed and in others many. In building a frequency distribution from these data one has figures for fewer lines of business than he would like to have and they are not as well covered geographically as he could desire. Therefore, he must make the assumption that the communities and lines of business used for the distribution typify the universe. The data were tabulated for all the non-manufacturing lines for which there were a reasonable

[4] The variation of the studies in respect to date from April 1943 to the present is a limitation which cannot be overcome because there is not an adequate number of studies as of any one date.

[5] The construction of distributions in these fields from average hourly rates narrows the range and dispersion, as it did in the case of mining and railroads, but not as much because within any single community the rates for particular occupations within the same industry do not vary greatly in general.

[6] The BLS made its Occupational Wage Rate studies chiefly as a service to the Regional War Labor Boards.

number of surveys in all regions of the country. In general, New York state data were used to typify the Middle Atlantic and New England states, Georgia for the Southeast, Texas for the Southwest, California for the Far West, Nebraska for the farm belt, and Ohio for the East North Central states. The choice of regionally typical states was not a free one; it was governed by availability of data as well as by considerations of representativeness. In some cases where greater representativeness or coverage could be secured by using states other than those listed above, that was done, but in general they proved to be the most satisfactory choice.

Frequency distributions were built up by states for each line of business tabulated. Because the number of non-manufacturing lines tabulated fell far short of the total number, the problem then arose of dividing the non-manufacturing lines into more or less homogeneous groups each of which could be typified by one of the lines for which data were available. For this purpose the United States Ceusus classifications were used.[7] In all of the service groups and in many of the retail trade groups, data were available for at least one line. In the case of apparel, furniture, automotive, lumber, hardware, filling stations, liquor stores, second-hand stores and other retail stores no figures were available. Therefore, it was necessary to construct estimated distributions for these groups. This is not as serious a limitation as it appears by counting groups because only about one-third of the retail employment is in the unrepresented categories.

Estimated distributions for the unrepresented groups were constructed in the following manner, suggested by the section above on manufacturing. There it was indicated that the shape of a distribution depends upon the occupational differentials and the distribution of employees among the several occupations. On a priori grounds one would expect lumber and hardware distributions to resemble in shape the wholesale distribution. In all three the bulk of the employees are relatively well paid salesmen who possess technical knowledge of the line and are in a position to advise customers. In all three there is a secondary concentration of warehouse, etc., employees at a lower wage level and all three have a small complement of bookkeepers, typists, etc., at another level. While the lumber and hardware distributions are similar in shape to the wholesale distribution, their averages are lower. Therefore, by the technique described in the manufacturing section, distribu-

[7] Retail trade: food, general merchandise, apparel, furniture, household and radio, automotive, filling stations, lumber and building materials, hardware, drug stores, eating and drinking places, liquor stores, second-hand stores, other retail stores. Services: business and repair services, personal services except domestic, amusement and recreational services.

tions for these two lines were constructed from the wholesale distribution (described later) such that they have the shape of the wholesale distribution but the averages appropriate to the hardware and lumber groups. By the same procedure distributions for the apparel, furniture and automotive groups were estimated from the known department store distribution. The latter has a larger percentage of inexperienced, low-paid clerks than the others but in most respects it is similar to them. All four use incentive payment systems. They all have a concentration of relatively well-paid specialty salesmen and another lower concentration of stockboys, typists, inexperienced salespeople and the like. In the case of the second-hand stores, other retail stores and filling stations the techniques used above could not be employed because neither distributions nor averages were available. These groups have the same sort of structure as grocery stores: a very few skilled, higher paid people and a host of low paid, unskilled clerks and attendants. Limited observation indicates that the earnings of workers in these establishments approximate those of grocery employees. Therefore, as an estimate, it was assumed that the known grocery distribution could typify these groups in addition to the food group.

The next step was to weight the six state distributions for each line of business tabulated to reflect the relative importance in the several regions of the groups typified by the lines in question.[8] Then the state distributions for each line were added to yield national distributions and these were inflated to the January 1944 employment in the groups they were used to typify.[9] Finally the inflated group distributions were added to obtain totals for retail trade, services, and finance, insurance and real estate.

The frequency distribution for individual lines of business from which the totals were built up are shown in Table III. The finance, insurance and real estate distribution is based on a 13,000 employee sample drawn from banks and insurance carriers. These concerns employ over half the employees of the group. The data for wholesaling were so meager that they were not broken down by lines. They are chiefly for grocery wholesaling except in New York where a number of other lines were also covered. The sample included 10,000 employees who constitute about 1 per cent of the total number. For these reasons it was felt that

[8] Data from the United States Census (1940) showing the number of wage and salary workers in each region and group were used as weights.

[9] Current employment data, which are compiled by the BLS, are available only for large groups, e.g. finance, services and miscellaneous. Therefore, it was necessary to estimate the January 1944 employment in the narrower industry groups used in the study by reconciling the BLS large group total for 1940 with the United States Census data for that year, which is broken down, and then applying to the current BLS total the percentage breakdown from the 1940 census.

the resulting distribution might approximate fairly well the shape of the true wholesale distribution but that it might not be at the proper level. The fact that its mean was about 20 cents below that calculated by the BLS from its sample of wholesalers who submit hours and wage bill data seemed to confirm this hypothesis, particularly in view of the fact that the BLS average for wholesaling and that based on census data had been very close on the last census date. Therefore, the frequency distribution resulting from the Occupational Wage Rate studies was adjusted to the BLS average for wholesaling by the method already described.

TABLE III
LINES OF BUSINESS UPON WHICH THE RETAIL TRADE AND SERVICES DISTRIBUTIONS ARE BASED

Line of business	No. of employees in sample	No. in sample as % of employees in line	Group typified by this line	Employment in line as % of employment in group
Department stores	27,000	5	Genl. mdse. dry goods & dept. stores	87
Grocery stores	25,000	4	Food, liquor, second-hand stores, other retail stores & filling stations	34
Restaurants	23,000	4	Eating & drinking places	68
Drug stores	11,000	6	Drug stores	100
Variety stores	135,000	13	Variety stores	100
Auto repair shops	7,400	3	Business & repair services	61
Hotels	17,000	5	Personal services, except domestic	73
Laundries & cleaning & dyeing plants	18,000	5		
Motion picture	7,700	6	Amusement & recreational services	33

Clearly, a frequency distribution which has been constructed by the means outlined cannot be regarded as more than an estimate. It is presented in the hope that pending the availability of more satisfactory basic data it may serve a useful purpose despite the reservations attached to it. The Occupational Wage Rate studies which supplied much of the raw data for this investigation are being continued, and after a time they should make possible more rigorous inquiries than the present one.

A SIMPLIFIED CALCULATION OF THE POTENCY OF PENICILLIN AND OTHER DRUGS ASSAYED BIOLOGICALLY WITH A GRADED RESPONSE

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THE RELATIVE potency of a drug or poison is frequently determined with a biological indicator which gives a graded response. When the response is a linear function of the logarithm of the dose within a useful range, experiments may be planned conveniently in factorial designs and evaluated through the analysis of variance [4]. More direct calculations for potency in the simplest of these designs have been suggested recently in two independent reports [6], [10]. A modified analysis has the advantage of leading directly to easy estimates of both relative potency and its standard error [2]. This procedure has been used in a U.S.P. collaborative study of the penicillin assay and is developed here in more detail.

Assays to which the present calculations apply are those with two doses of each of two preparations, referred to as "standard" and "unknown." The ratio of the larger to the smaller dose of the unknown, U, must always be the same as in the standard, S, so that $U_2:U_1=S_2:S_1$. The two doses of the unknown are selected so that their expected potencies will be the same as those of the standard, as nearly as this can be determined in advance. The assumed potency is then corrected by biological assay. By isolating the differences for each individual degree of freedom of direct interest to the experimenter, the potency of an unknown and its standard error can be computed with a minimum of arithmetic from such 2×2 factorial designs.

As a further restriction the experiment must be arranged in complete sets, each containing all four doses. These sets are then repeated until the results have the required precision. A set may consist of four successive reactions in the same animal, four litter mates of the same sex, four groups of animals tested at the same time or other groupings of similar units. Within each set the four doses are assigned in a random order, one to each unit. Differences between groups of four are segregated from the estimate of potency and of its error, but are not measured directly.

Basic data from a typical assay.—The method may be illustrated by an assay of histamine based upon the contraction of a section of guinea

pig gut as reported by Schild [9]. The tissue was immersed successively in two different concentrations of the standard and of an unknown preparation. The muscle reacted to each solution so that the height of contraction as recorded on the kymograph was a linear function of the log-concentration of histamine.

Successive contractions, however, tended to decrease in height, quite apart from the concentration in which the muscle was immersed. This change in the inherent capacity of the muscle was balanced by grouping successive contractions into sets of four representing two doses of the standard and two doses of the unknown. To give each concentration an equal chance of being tested at the beginning or end of a set, their order within sets was randomized.

As is customary in testing a new procedure, the unknown was here a known concentration of the standard. Hence the accuracy as well as the precision of the assay could be measured objectively. The original heights of response in one-half millimeters are shown in the left side of Table I.

TABLE I
ASSAY OF HISTAMINE

Set No.	Height of contraction for				$D_1 = U_2 - S_2$	$D_2 = U_1 - S_1$	$D_3 = U_2 - U_1$	$D_4 = S_2 - S_1$	$y_1 = D_1 + D_2$	$y_2 = D_3 + D_4$	$y_3 = D_1 - D_2$
	U_2	U_1	S_2	S_1							
1	131	103	122	89	9	14	28	33	23	61	− 5
2	132	104	122	92	10	12	28	30	22	58	− 2
3	136	87	118	84	18	3	49	34	21	83	15
4	112	74	110	66	2	8	38	44	10	82	− 6
5	106	73	98	50	8	23	33	48	31	81	−15
								Total	$107 = T_1$	$365 = T_2$	$-13 = T_3$

The first step in the analysis is to compute four differences from the four observations of each set, as shown in the second part of Table I. The successive differences are those of the unknown minus the standard at the high (D_1) and at the low (D_2) dosage levels and of the high minus the low dose for the unknown (D_3) and for the standard (D_4). These initial differences are then used to obtain the basic computing units, y. The values for $y_1 = D_1 + D_2$ total the effect of the difference between the two preparations while those for $y_2 = D_3 + D_4$ total the effect of the difference between the two dosage levels. The differences $y_3 = D_1 - D_2 = D_3 - D_4$ test whether the dosage-response curves for standard and unknown are parallel. Computing y_3 in two ways checks the correctness of the original differences. The y's for each set are the

orthogonal differences from the standard 2×2 factorial design [4]. They are summed to obtain T_1, T_2 and T_3 respectively, as shown in Table I.

Equations for computing relative potency and its standard error.—The potency assigned to the unknown in the course of an assay is corrected from totals such as in the lower part of Table I. The average difference in response between the standard and the unknown for N sets is $T_1/2N$. This difference is converted to units of log-dose by dividing by the average slope of the curve relating response to log-dose (Equation 3). Hence, the amount of the unknown assumed to have the same potency as the standard is estimated to have a relative log-potency of

$$M' = \frac{IT_1}{T_2}, \tag{1}$$

where I is the logarithm of the dosage interval or of the ratio of the high dose to the low dose for both standard and unknown. The potency assigned to the unknown in preparing the test doses U_1 and U_2 is then corrected, by computing

$$M = \log\ (\text{assumed unitage or potency}) + M'. \tag{2}$$

The antilogarithm of M is the most probable estimate of the potency of the unknown for a single unit assay.

The precision of an assay is no greater than that shown by its standard error, s_M, and may be considerably less. Some factors are constant within but not between assays, such as the initial stock solutions and details of technique which differ with the experimenter or the laboratory. These do not appear in the computed s_M although their importance is judged by comparison with the standard errors of individual assays. Before computing s_M, three other values are determined from the y's and their totals. These are the combined slope (b) of the dosage-reponse curves for standard and unknown, the standard deviation (s) for a single observation in terms of the response, and the ratio (λ) of s to b or the standard deviation converted to units of log-dose.

With only two doses of the standard and of unknown, the slope may be computed by dividing the average increase in y due to a difference in dose, $T_2/2N$, by the difference in the log-dose (I), so that

$$b = \frac{T_2}{2IN}, \tag{3}$$

where N is the number of sets or groups in the assay. The standard

deviation is estimated from the variation of the y_1's, y_2's and y_3's about their respective means. These three components are assumed to represent different samplings from the "same universe" of variation, which are combined into a single more reliable estimate than could be obtained from any one component. In terms of a single response (not of a difference) the best estimate of the population standard deviation is given by the equation

$$s = \sqrt{\frac{S(y^2) - (T_1^2 + T_2^2 + T_3^2)/N}{12(N-1)}}, \tag{4}$$

where y refers to all individual values of y_1, y_2 and y_3, and $S(y^2)$ is the sum of their squares. With a calculating machine Equation 4 can be solved directly without recording any intermediate steps. In its absence it is useful to write down the squares of the y's and of the T's from any convenient table of squares. The standard deviation in the response is then divided by the slope to convert it from units of response (y) to units of log-dose (x) and we have

$$\lambda = \frac{s}{b}. \tag{5}$$

The smaller this term, the more sensitive is the method of assay for detecting differences in potency. As a measure of the inherent precision of the technique, λ should be relatively stable from one test to another.

The above statistics are of direct interest in critical studies of an assay technique but they are used immediately in a convenient equation for the standard error (s_M) of the log-ratio of potencies. As orthogonal terms, the totals T_1 and T_2 in Equation 1 are assumed to be independent of each other. The variance of M' may then be written as

$$V\left(\frac{IT_1}{T_2}\right) = \frac{I^2T_1^2}{T_2^2}\left\{\frac{V(T_1)}{T_1^2} + \frac{V(T_2)}{T_2^2}\right\},$$

where V stands for the variance of the terms in parentheses. Substituting $4Ns^2$ for the variance of both T_1 and T_2 and $1/Nb^2$ for $4I^2N/T_2^2$, a simple algebraic transformation gives the equation[1]

$$s_M = \lambda\sqrt{\frac{1}{N}\left\{1 + \frac{T_1^2}{T_2^2}\right\}}. \tag{6}$$

[1] Equation 6 has been derived in several ways. The starting point for that given here is based upon a suggestion from Miss Lila Knudsen of the U. S. Food and Drug Administration. Where the population standard deviation for y_1 is known to differ from that for y_3, Equation 4 does not hold and Equation 6 necessarily takes another form.

The more nearly equipotent the concentrations of the unknown and of the standard used in carrying out the assay, the smaller is T_1 and the more nearly s_M approaches a minimum.

$M \pm s_M$ are computed in logarithms, so that critical tests of statistical significance should be made in the same terms. As noted by several workers, most recently by Finney [6], the formula for s_M is itself an average of unequal lower and upper limits, which may differ appreciably unless the ratio s^2/T_2 is a small number. When values which are approximately equidistant in logarithms are converted to original units, the lower confidence or fiducial limits are necessarily nearer to the most probable value than the upper limits. If one is willing to neglect this discrepancy, an average standard error may be computed as

$$\text{standard error of potency} = 2.30 s_M \text{ (antilog } M\text{)}. \qquad (7)$$

Example.—These equations may now be applied to the histamine assay in Table I. Since the unknown is here assumed to have the same potency as the standard, the logarithm of relative potency is given directly by M'. Substituting in Equation 1 the values from Table I, with $I = 0.3010$, $M = M' = 0.3010 \times 107/365 = 0.08824$. The antilog of M is 1.225, so that the unknown is assayed as 122.5 per cent as potent as the standard.

The standard error of this estimate requires three other values. The slope of the dosage-response curve is given by Equation 3 as $b = 365/(2 \times 0.3010 \times 5) = 121.3$ and the standard deviation of a single response by Equation 4 as $s = \sqrt{\dfrac{30289 - 144843/5}{12(5-1)}} = 5.245$. The ratio of these two terms gives $\lambda = 5.245/121.3 = 0.04324$. In comparison with other biological assays [3], λ indicates a relatively sensitive technique.

Substituting in Equation 6, $s_M = 0.04324\sqrt{1/5\{1 + 107^2/365^2\}} = 0.02015$. From Equation 7, the approximate standard error of percentage potency is $2.30 \times 0.02015 \times 122.5 = 5.7$ per cent. Hence, the "unknown" histamine has an assayed potency 122.5 ± 5.7 per cent that of the standard. Since its true potency is given by Schild as 125 per cent, the accuracy of the assay was well within the estimate of its precision.

Computation when $I = 0.5$.—The calculation may be further simplified if the experimenter will design his assays so that the ratio between doses is $U_2 = 3.16\ U_1$ and $S_2 = 3.16\ S_1$, giving a log-ratio of $I = 0.500$. This modification was first proposed by Dr. Lloyd C. Miller, to whom I am indebted for the data in Table II. It has been used successfully

in the penicillin assay at the Winthrop Chemical Co., Inc., for many months [8]. With this change Equation 1 becomes

$$M' = \frac{T_1}{2T_2} \tag{1a}$$

and Equation 3 becomes

$$b = \frac{T_2}{N}\,. \tag{3a}$$

The other formulae are not affected.

The procedure may be illustrated by the data in Table II from two routine plate assays of the same sample of penicillin by the Oxford cup technique. Both S_2 and U_2 were prepared initially to contain a known and an assumed concentration respectively of 2.0 U/cc. The weaker dilutions were obtained by adding 2.31 cc. of S_2 and of U_2 to vessels containing 5.00 cc. of buffer solution. The dosage interval in logarithms for the resulting test solutions was $I=0.500$.

TABLE II

CYLINDER-PLATE ASSAY OF PENICILLIN

Plate No.	Diameter in mm. for 1st assay				Diameter in mm. for 2nd assay			
	U_2	U_1	S_2	S_1	U_2	U_1	S_2	S_1
1	25.8	20.8	25.6	20.4	26.0	21.0	25.4	20.6
2	25.8	21.0	25.2	20.4	26.0	20.8	25.4	20.2
3	25.4	20.4	24.8	20.0	25.6	20.8	25.2	20.2
4	25.8	20.8	25.2	20.4	25.8	20.8	25.2	20.4
Total	$T_1=3.8$ $T_2=39.4$ $T_3=0.2$				$T_1=4.2$ $T_2=39.8$ $T_3=0.2$			

In the present assay the unknown was assumed to have a potency of 400 Oxford units per milligram. Solving with the values in the first assay of Table II, we find that $b=9.85$, $s=0.1167$, $\lambda=0.01185$, $M'=0.0482\pm0.0060$, and by Equation 2, $M=2.6503\pm0.0060$. From the anti-log of M, the unknown had an assayed potency of 447.0 ± 6.2 U/mg. This agreed well with the second assay of the same preparation, which gave 451.7 ± 5.6 U/mg.

Test for validity.—In the above procedure it is assumed that the standard and the unknown are qualitatively alike and that the doses fall on a part of the dosage-response curve where the response is essentially a linear function of the log-dose. If slopes computed separately for the standard and the unknown were to differ appreciably from

parallelism, one or both of these assumptions would be invalidated. Hence, the test for the parallelism of the dosage-response curves checks the validity of the assay. It is computed from the ratio of T_3 to its standard error, giving

$$t = \frac{T_3}{2s\sqrt{N}}, \tag{8}$$

where t is that in the t-test for significance. The observed t is referred to a suitable table [7] with $3(N-1)$ degrees of freedom. If it exceeds the value for $P=0.05$ or in repeated assays is persistently close to that value, the assumption of qualitative equivalence should be questioned or the dosage range revised.

The test may be illustrated with the data in Tables I and II. For the histamine assay, $t=13/(2\times 5.245\times\sqrt{5})=0.55$ with $3\times 4=12$ degrees of freedom. The probability that a t of this magnitude could occur by chance is $P=0.6$, so that here there is no evidence of diverging dosage-response curves for standard and unknown. The corresponding t's for the two penicillin assays were 0.43 and 0.47 respectively with 9 degrees of freedom, neither showing any lack of parallelism.

Analysis of multiple assays.—The above technique provides an estimate of potency and its standard error from the data of an individual experiment. Since relatively few observations are involved, these depend upon estimates of b and s which are necessarily less stable than if based upon larger numbers. Frequently, however, similar assays are carried out together or repeated routinely. Under these conditions both the slope (b) and the standard deviation (s) of the individual tests should be compared. The variation between tests may fall well within the sampling error in most or all assays for a given day, week or longer period, as has been observed with penicillin. The slopes can be compared readily by the analysis of variance and the standard deviations by the χ^2 test for the homogeneity of a series of variances, both standard techniques.

Occasionally the standard deviation is correlated positively with the slope, so that λ may be relatively stable even though s and b vary significantly. This seems to be true, for example, in the histamine assays reported by Schild [9]. For determining the agreement between different estimates of λ, the standard error of λ may be computed as

$$s_\lambda = \lambda\sqrt{\frac{1}{6(N-1)} + \frac{\lambda^2}{NI^2}}\,. \tag{9}$$

The homogeneity of a series of statistics can be tested by χ^2 when their standard errors are known [1].

An assay technique has not been fully standardized until the variability in s and b or λ is within the limits of random sampling. The procedure is then said to be in a state of statistical control, which brings substantial advantages to the experimenter. The agreement of individual assays with past experience is checked graphically by a control chart technique, as will be described elsewhere for the cylinder-plate assays of penicillin [5]. If a given assay meets this requirement, the calculation of potency is further simplified. Since the standard error depends only upon the number of sets (N) it need not be computed individually for each assay.

Cases arise, however, intermediate between the individual test and the stabilized routine assay with its control charts. It is desirable to combine standard deviations and slopes when their estimated values in two or more similar assays agree within the sampling error. The individual variances (s^2) provide an improved estimate of the standard deviation by the usual formula

$$s_c = \sqrt{\frac{S(ns^2)}{S(n)}} \tag{10}$$

where $n=3(N-1)$ or the degrees of freedom in each individual estimate. If the slopes are parallel and I is constant in tests with the same s_c, their combined value may be computed as

$$b_c = \frac{S(T_2)}{2IS(N)} \cdot \tag{11}$$

Then the relative log-potency of each assay is determined from its observed T_1 as

$$M' = \frac{T_1}{2Nb_c} \cdot \tag{12}$$

The standard error of the M' obtained with the pooled estimate is

$$s_M = \lambda_c \sqrt{\frac{1}{N}\left\{1 + \frac{S(N)}{N}\left(\frac{T_1}{S(T_2)}\right)^2\right\}}, \tag{13}$$

where $\lambda_c = s_c/b_c$, N is the number of sets in an individual assay and $S(N)$ the number in the whole series to which it belongs. When several values

of M are to be compared or combined, Equation 13 leads to more precise results than Equation 6.

Summary.—An easy calculation of relative potency and its error is described for biological assays that meet certain experimental requirements. These are (1) a graded response, some function of which is linear over a working range of log-dose, (2) arrangement of the individual reactions in relatively homogeneous sets of four, (3) testing within each set two different doses of both a standard and an unknown in a random order and (4) use of the same ratio between the two doses of each preparation.

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A METHOD OF ANALYSIS OF FAMILY COMPOSITION AND INCOME

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Billions of dollars have been distributed in the past twelve years on the basis of "need" in low income families. The obverse of the term "need" may be designated as "adequacy." Theoretically, the need of a particular family is determined by subtracting its resources from a more or less defined yardstick of adequacy. Likewise, many wage disputes revolve around the concept of requirements for adequate family support. This concept also entered to a large extent into the determination of the scale of allowances for the families of the armed forces, and, presumably, will influence the allocation of commodities in the post-war international relief programs. In spite of the wide administrative use of this concept, much more research is needed before sufficient precision can be obtained in scales designed to measure adequacy for individuals of different ages, sexes, and in different regions.

There are two general classes of yardsticks which, for convenience, we shall designate the "theoretical" and the "average." The theoretical approach consists in defining a standard of living in terms of specific goods and services considered as necessary for particular ages or classes of people. These goods and services may be priced at various times and places and the cost compared to the income available to various types of families or to a particular family.

The average approach consists of an effort to measure the relationship of the actual incomes of various types of families, using as a yardstick the median per capita for the Nation, region, or state under consideration. In effect, this method compares the income available for the members of any particular type of family with the actual income below which half the families get along.

A method of developing the average approach will be discussed in this article. The application of the method will first be described without reservations as to accuracy. The assumptions involved and the shortcomings in the data will be pointed out at the end of the article.

Direct comparison of family incomes is, of course, not very revealing because families vary in composition and the needs of adults and children are not equivalent. Incomes should first be reduced to a per capita basis, and the various types of family members should be assigned dif-

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ferent per capita weights. For the purpose of this yardstick, adults (over 18 years of age) will be assigned one full unit and children (under 18 years of age) will be assigned one-half unit in determining family unit composition.

Family composition is tabulated in the Census of 1940 in considerably more detail than in any previous Census and, for some types of families and geographic divisions, income is cross-tabulated by type of family. Average family composition for all private families is available directly from Table 11, "Population—Characteristics by Age," for the United States as a whole and for each state in Table 13 of the state tabulation of characteristics by age. These tables yield the following averages by residence of family (after excluding servants and lodgers):

Total individuals
Heads of families and their wives
Children under 18
"Extra" adults

This composition may be reduced to family units by weighting the children under 18 one-half, the adults one, and summing the result. Income distributions by regions are available in Table 9, "Population—Family Wage or Salary Income," and for states and cities over 100,000 in Table 34, "Population and Housing—Families—General Characteristics," and for cities over 100,000 in Table 59 of the same volume. Income by type of family for cities is, however, not published.

The division of the median family income of a state, region, or city by the family units in the average household composition will yield the family units of the median income for all families in the area under consideration. Such calculations should be limited to those families reporting wage and salary income *without* other income, since those families *with* other income do not have the "other" income included in their total. For this group the published figure is only a partial family income. Of the 35 million wage or salary earning families in the United States, about 16 million are non-farm families with wage or salary income only. If it is desired to analyze these incomes by frequency distributions or according to various family types, it is necessary to make computations involving a number of different tables in various volumes of the Census, and the note on computation at the end of this article will serve as guide for locating and processing these data.

The family units for the types of families with wage or salary income only which result from such computation are shown in Table I.

The constant rise in the number of adults and decline in number of children as income increases causes an increase in average number

TABLE I

AVERAGE PERSONS IN UNITED STATES FAMILIES, WITH WAGE OR SALARY INCOME ONLY, URBAN AND RURAL NON-FARM COMBINED, BY FAMILY UNITS AND INCOME

(1) Income	(2) Total persons	(3) Adults	(4) Children under 18	(5) Family units
All Families	3.460	2.336	1.124	2.898
$1–$499	3.146	1.987	1.159	2.566
$500–$999	3.354	2.142	1.212	2.748
$1,000–$1,499	3.419	2.232	1.187	2.825
$1,500–$1,999	3.465	2.326	1.139	2.895
$2,000–$2,499	3.545	2.489	1.056	3.017
$2,500–$2,999	3.706	2.746	.960	3.226
$3,000–$4,999	3.943	3.049	.894	3.496
$5,000 and over	3.978	3.062	.916	3.520

of family units per family in each successive step in the income distribution. Similar computation for states by income steps is possible by adjusting the state averages of adults and children in all families to families with wage or salary income without other income with the same degree of difference as is shown in the region; then distributing this total by income steps in the same degree of variation as shown in the region. Computation of states by family types requires a special tabulation from the Census similar to Table 9, "Wages or Salary Income, 1939, for the United States."

Comparisons of medians of per capita wage or salary incomes by types of family from Table 9, "Population—Families—Wage or Salary Income, 1939," cited above, are shown in Table II.

With this "average" method of measuring adequacy in mind, it is possible to distinguish between it and the "theoretical" approach. In 1944 the Textile Workers' Union of America, in cooperation with the Bureau of Labor Statistics, priced an "emergency" budget in two North Carolina textile towns. This budget includes commodities and services originally selected by the WPA as the basic minimum needs of relief families but was modified with respect to the food items to adjust for more recent nutritional standards. It includes only low quality goods in limited amounts and is conceded to afford a level of living much below the needs of the average family for minimum comfort and satisfaction. The cost of the items in this budget in 1944 was found to be $1,413 in High Point, North Carolina, and $1,369 in Henderson, North Carolina, or roughly $1,400 in towns of this category. On the basis of 1939 prices, this is equivalent to $1,110 (allowing for an increase of 26 per cent in the cost of living from 1939 to 1944).

TABLE II

FAMILY UNIT INCOMES OF FAMILIES WITH WAGE OR SALARY INCOME ONLY, BY TYPES AND NUMBER OF CHILDREN UNDER 18 YEARS OF AGE. URBAN AND RURAL NON-FARM FAMILIES, 1939

Type of family	United States			Southern region		
	Median family income	Family units	Median income per unit	Median family income	Family units	Median income per unit
All families	$1,380	2.92	$474	$ 965	2.92	$330
Male head with wife:						
No children	1,563	2.46	635	1,144	2.42	473
1 child	1,480	2.96	500	1,164	2.92	400
2 children	1,475	3.46	426	1,133	3.42	331
3 or more children	1,223	4.46	274	885	4.40	201
Male head other:						
No children	964	1.57	614	659	1.53	430
1 child	1,304	2.07	630	832	1.93	431
2 children	1,250	2.57	486	829	2.53	328
3 or more children	1,100	3.53	312	735	3.47	212
Female head:						
No children	986	1.96	503	568	1.90	300
1 child	840	2.46	341	501	2.40	209
2 children	774	2.96	261	472	2.90	166
3 or more children	588	3.90	151	410	3.84	107

Since this budget is designed to support, at the emergency level, a man, his wife, one child 7 to 9 years of age, and one child 13 to 15 years of age, it represents roughly $3\frac{1}{4}$ family units (counting the adults as one unit each, the child 7 to 9 as one-half unit, and the older child as three-fourths of a unit). The unit equivalent cost of the emergency budget was about $341 as against the North Carolina equivalent median family income of $308. This comparison, as crude as it is, indicates that families living below the median level in North Carolina are not provided with the goods and services which are needed for the kind of opportunities for children required by a sound democracy.

This indicates clearly the dilemma in choosing between the two methods of determining adequacy for a particular family. The person who is genuinely interested in improvement will want to measure adequacy not merely by the "emergency" level budget but at some higher level more nearly representing desirable standards of comfort. Yet, when an emergency budget is priced in many areas, its cost is found to be above the level at which more than half of the families actually get along. On the other hand, hard-boiled administrators and legislators who do not

believe in "pampering" the needy will not subscribe to a level of adequacy which is above the customary living level of a large segment of the self-supporting population. For them the concept of average adequacy may have more realistic validity.

As has been shown in the preceding paragraph, however, it is possible by constant and widespread pricing of "theoretical" budgets to compare the two yardsticks and enable planners and administrators of a particular program to choose one or the other or a compromise between the two.

Students of family composition and income distribution will recognize immediately that the foregoing discussion has passed over some rather broad assumptions with the result that the conclusions are approximate at best.

The assignment of one unit to adults and one-half unit to children is in itself debatable. As indicated at the outset, much more research is needed on this point. Since, however, the conversion to family units is one of the final steps in this method, the analysts with more refined scales available may assign different weights to suit their purposes.[1] W. S. Woytinsky, (*Earnings and Social Security in the United States*, pages 233–236) in using a similar method, comments that its chief virtue is in its simplicity. There will always be much subjective judgment involved in allocating consumer weights to persons of various ages, since at a given income level some parents will sacrifice their own needs to provide for the children, and others will follow the opposite course. Likewise, "pooled" expenditures, such as for rent, heat, light and furnishing, have to be arbitrarily allocated among family members.

Accuracy of income reporting is also doubtful. Any approach to family income by enumeration is as fallible as human memory. Some cross checks between wages and salaries as reported to the Census and those reported by employers to the Treasury as social security tax returns indicate some under-statement in the Census. The extent to which this error is distributed by income classes should be the subject of further investigation, as this distribution of error after all is more important in comparisons than the actual amount of under-statement.

In fact, the errors involved in income reports and the method of tabulation which presents the data in broad steps of $500 in each step would lead to the conclusion that the crudities in income data would to a large extent mask any minor fluctuations which might arise from crudities in the scale of adult equivalents used.

A second drawback to the income data is the fact that they are the

[1] The use of family units in income is similar to the use of consumer units in measuring expenditures.

cross-section picture as of 1939 and projections for subsequent years would involve assumptions as to the change in income distribution.

Both of these defects in the application of this method to incomes reported to the Census could be overcome to a large extent by a more detailed presentation by the Treasury Department of analyses of incomes reported for taxation together with exemptions claimed for minor dependents. Such data will relate to individual and not to family incomes, but since they should be available annually, they will afford indices of change of income distribution from year to year.

If the method of reducing income to family unit income is applied to states, it must be remembered that the income-family composition data are based on a sample and that the final results are finely subdivided. Hence, in the smaller cells of the table considerable sampling errors may occur. For instance, non-farm families with wage or salary income only and with male head, no wife, and three or more children, constitute only about .0014 of the total families, and, if such a small category is further distributed by income frequency or color, unreliability may occur.

There are also certain assumptions underlying the calculations of family composition. The subdivision of families into those with 0, 1, 2, and 3 or more children necessitates the assumption that the number of extra adults is the same in these four types of families. The assignment of the same unit value to all children and the same to all adults assumes that there are no economies in buying and planning which are available to the larger families but not to families with only one or two children. It is also assumed that family composition as enumerated in 1940 was approximately the same as in 1939—the year for which income data were secured.

There is likewise a mathematical difficulty involved in dividing median income by the arithmetic average size of family. This procedure yields the per capita equivalent for the family with the median income which is the general summary of the relationship between the income series and the family composition series. Several other alternatives for relating these series are possible. A median of per capita incomes is published by the Census under the designation of "median per capita income" and has been calculated by computing the average income of families of each size within each income step and computing the median of this array of per capita incomes. The difficulty of this method is that it assumes that the incomes within each step of the frequency distribution are distributed evenly around the midpoint of the step. The other difficulty is that such detailed calculation is not possible for types of families or for subdivisions of the total population.

A second possibility is the comparison of the estimated average income to the average size family. The difficulty with this method is that it involves estimating the amount of income which is earned by families in the $5,000 and over category, which amount was not enumerated by the Census.

Also, it is possible to compare the composition of the family in the median income step to the median income. This latter procedure does not yield results materially different from the one here proposed.

None of these methods of comparing the two series is entirely satisfactory. The most important consideration in making comparisons between types of families and areas is to use the same summary measure in both of the elements which are to be compared.

To summarize the foregoing statement of shortcomings in the data and methodology, it may be said that the measure which has been evolved is one of general relationship between family composition and income and is not suitable for the discrimination of small differences. The discrepancies in unit income equivalents, however, which appear in Table II are so wide, and similar comparisons between states in different regions so pronounced that the measure may be recommended to those who wish to make general comparisons of incomes on the basis of the number of people which the income supports.

The method proposed for analyzing family composition is useful by itself even if no attempt is made to relate it to income distribution. For this purpose the computation is greatly abbreviated and the result is subject to only minor errors. It provides accurate comparison by states, by residence, by family, and by age of the head of the family, of family composition in these various categories.

The utility of analysis of family composition without reference to size of income is indicated by Table III which shows the distribution of children and adults by residence and by type of family.

The non-farm wage or salary workers only comprise the industrial and white collar workers. The non-farm "other income" group is a miscellaneous residual. The farm "wage or salary income only" comprises the laborers in farm families and the "other income" group is for the most part composed of farm operators.

NOTE ON COMPUTING FAMILY COMPOSITION BY INCOME AND FAMILY TYPE

Step 1. If all non-farm families with wage or salary income only are to be analyzed, it is necessary to combine the family members in urban and rural non-farm families to obtain the total population in such families. As was pointed out in the text, this computation can

TABLE III

AVERAGE FAMILY COMPOSITION BY RESIDENCE AND BY FAMILY TYPE, UNITED STATES 1940*

Family type	Urban and rural non farm		Farm	
	Wage or salary income only	Other income	Wage or salary income only	Other income
Male head with wife				
Adults	2.458	2.554	2.531	2.790
Children	1.270	1.214	1.944	1.758
Male head, other status				
Adults	1.570	1.694	1.524	2.008
Children	.378	.319	.576	.562
Female head				
Adults	1.655	1.870	1.940	2.294
Children	.964	.558	1.342	1.085

* Composition is as of 1940; Income status as of 1939.

be made from Table 11, "Population—Characteristics by Age," for the United States and Table 13 of the state tabulations of characteristics by age for each state. It is necessary to subtract servants and lodgers from the total. Unfortunately, regional totals of this table by residence are not published, and it is necessary either to add up the states in a region or secure a special tabulation from the Census.

Step 2. From "Population—Families—Size of Family and Age of Head," Table 8 for the United States and Table 9 for regions, add together all persons in families of 1, 2, 3, 4, 5, and 6 members and subtract the total from the total obtained in Step 1 to obtain the number of persons in 7 or more person families in the whole non-farm population.

Step 3. To convert the number calculated in Step 2 into an average for families with wage or salary income only, calculate the percentage of all persons who are in 6-person families with wage or salary income only and apply this percentage to the total persons in families of 7 or more members. Reduce to an average. (Except for highly refined calculations, this step may be omitted and the average persons in 7-person families secured from Step 2 may be applied directly to the number of non-farm families with wage or salary income only. The error arising from this shorter process affects only the third decimal place of the number of adult equivalents. In view of the crudities in the income data into which adult equivalents are divided, the error is most negligible.)

Step 4. Reduce the number of members of 7-person families obtained in Step 3 to an average per family.

Step 5. Multiply this average by the number of 7-person families headed by a man and wife, by a man alone, or a woman alone.

Step 6. Multiply the same average by the number of 7-person families in each income step in each of the family types used in Step 5.

Step 7. The two preceding steps have yielded a distribution of the number of persons in 7-person families which can be added in each cell of the table to the actual number in families of 1, 2, 3, 4, 5, and 6 persons, the sum being the number of persons in each income step of each family type. These totals, divided by the number of families in the corresponding cell, yield the desired distribution of the average persons per family in each category. The distribution of average total persons by income steps for all types of families combined is shown in Column (2) of Table I in the text.

Step 8. Total children under 18 years of age were obtained in Step 1. Children in all families are distributed in Tables 5 and 6 of "Population—Families—Types of Families," except that as in case of the total number of persons there is an open-end category of 6 or more children and in order to distribute this number properly, a computation similar to Steps 2 through 6 is necessary, yielding the total number of children in all families with wage or salary income only. The number in 1 and 2 child families subtracted from this total yields the number in 3 or more child families. This can be reduced to an average.

Step 9. Families with 1, 2, and 3 or more children are distributed by family type and income steps for the United States and for regions in Table 9, "Population—Families—Wage or Salary Income, 1939." From this table, it is possible to calculate for each cell the number of the children in 1 and 2 child families. The average number in 3 or more child families times the number of such families in each cell yields the number of children in 3 or more child families which, combined with those in 1 and 2 child families, gives the total children in families in the cell. This calculation is only necessary if it is desired to analyze per capita incomes by type of family according to the number of children in the family as shown in Table II of the text.

Step 10. Average children under 18 years of age per family can be deducted from average total persons per family as calculated in Step 7 and the difference represents the average adults in the family. (Shown in Column (3) of Table I, text, by income steps.)

Step 11. Divide the average number of children by 2 and add to the average number of adults to secure the average family units per family.

Step 12. Divide median income of the categories under consideration by the average units per family to reduce total family income to family unit income.

DETERMINING SAMPLE SIZE

By J. A. Nordin
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One possible purpose of a marketing survey is to determine the strength of a potential market. Suppose that the sampler intends to build a plant, in order to enter the market. The scale of his plant will depend on his information about the market. A sample will furnish his information; thus it will determine the scale of plant.

The larger the sample, the more accurate its information. The better the information, the more profitable the plant will be. But enlarging the sample entails cost. Therefore there is need of a theoretical background for determining the optimum size of the sample.

Let each potential customer be considered a sub-market, with H_i a number representing the strength of the i^{th} sub-market. Let H_t be the strength of the whole market, consisting of m potential customers.[1] The sample of n will include n "H_i"s, and have a mean $\bar{H}'$.

In the market there is a standard deviation, σ_{H_i}, a measure of the dispersion of the "H_i"s, and a sample of n will have a standard deviation, σ_s.

On the basis of $\bar{H}'$ and σ', there is a probability[2] for each possible value of $\bar{H}$. A plant will be selected on the basis of the whole array of probabilities. Let α represent the size of the plant.

There will be some profit expectation per production period, determined by α and the probability array. On the basis of the sample of n, the net worth of the investment opportunity is the product of the profit expectation per period and the number of periods.

If the profit expectation can be raised, the net worth of the investment opportunity can be raised. The rise in net worth will be the value of the action raising the profit expectation. If the sampler can get an unbiased estimate of the change in net worth that will be caused by an action, the estimate can be considered the value of the action.[3] To decide whether to take the action, the sampler will compare its value with its cost.

The action to be discussed here is the addition of the $(n+1)^{th}$ item to the sample. If the sampler can decide whether to add the item, he has a method for determining the optimum size of sample.

[1] H_i and H_t are given more specific meanings on p. 499.

[2] For details, see p. 502.

[3] An unbiased estimate of a parameter is one that has no net tendency either to overstate or understate the parameter.

The economic setting of the problem must be assumed in detail, so that profit expectations can be computed. The assumptions are as follows:

1. All raw material enters the plant at one time, and all finished product emerges at one time. The intervening period will be called the production period.
2. The production period is fixed.
3. The sampler's planned action is that of selecting a scale of fixed equipment, α.
4. Whatever the value of α, the life of the equipment is a constant.
5. Fixed cost per production period is a constant multiple of α. Let the multiplier be C.
6. The plant is to produce only one product.
7. On a range $x=0$ to $x=D\alpha$ (where D is a constant and x is output per period) marginal production cost is a constant for any α. This assumption is in accord with the findings of factual studies.[4]
8. The maximum production is $D\alpha$. With a given plant, there must finally be an end to adding equipment and increasing the hours of work and the number of shifts. The element of unreality seems to lie not in positing an output limit, but in neglecting a marginal cost rise before the output limit is reached.
9. The marginal production cost curve can be reduced by increasing the size of the fixed equipment. Concretely, it will be assumed that marginal production cost is A/α, where A is a constant.[5] Certainly it is possible to substitute fixed and variable cost marginally at the time when the plant is built. If the function chosen should prove inappropriate, another could be substituted.

The foregoing assumptions have dealt with production conditions. The picture presented is essentially that of a break-even chart. The U shaped marginal production cost curve common in economic assumptions has been avoided, since apparently it is not prevalent. The break-even chart has not been popular among economists—perhaps because it gives the impression that unlimited extension of sales is desirable. The break-even chart must be modified to include selling facts. A marginal selling-cost curve must be drawn to indicate the cost of selling each additional item.

10. When additional units of an industrial product are to be sold to

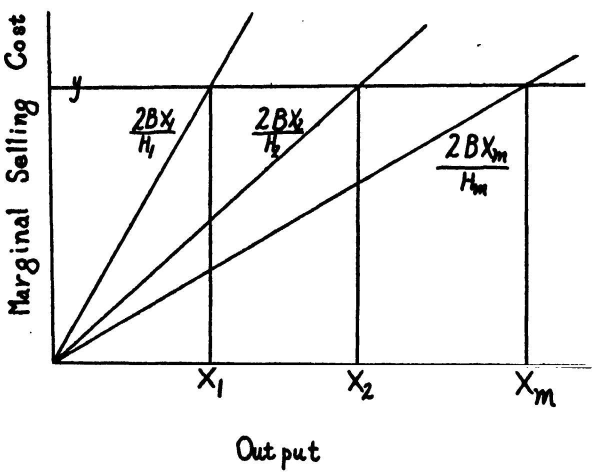
[4] E.g., Joel Dean, *Statistical Cost Functions in a Hosiery Mill*, Chicago University Studies in Bus. Adm. vol. 11, no. 4.

[5] The 8th and 9th assumptions together preclude separate variations in marginal production cost and maximum output.

a customer, the salesman must spend increasing increments of time surveying the customer's plant to discover additional uses for the product. Thus it is very reasonable to assume that the marginal selling cost curve is a rising line in each sub-market. The choice of function will depend on the indications given by the estimated marginal selling cost curves of the first n plants sampled. It will be assumed that the function is $2Bx/H_i$, where B is a constant. Pending the gathering of adequate information on the nature of selling cost curves, a straight line may reasonably be used as an approximation. H_i (the indicator of the strength of the sub-market) is here given a specific algebraic meaning.

11. Selling price is assumed known. Actually, the price and the scale of plant might be determined simultaneously. The analysis could be extended, though with some difficulty in manipulation, to cover the wider problem. To avoid unnecessary complication it will be supposed that industry custom sets the price.
12. The final assumption is that there is no subjective time discount. Introducing time discount would complicate the analysis to an extent out of proportion to the amount of realism gained.

CHART I



Before the assumed case is investigated, it may be useful to look at the economic adjustment that would be made if there were no uncertainty about selling conditions. Assume that there are m potential customers, each with an H_i. Chart I shows some of the marginal selling cost curves. It can be shown that the market parameter, H_t, is the sum

of the individual "H"s for the sub-markets. For the i^{th} customer, the common marginal selling cost level is $y = (2Bx_i/H_i)$. Total selling cost is

$$W = \frac{y}{2} \sum_1^m x_i. \tag{1}$$

Total sales are

$$x = \sum_1^m x_i. \tag{2}$$

For the whole market, marginal selling cost is

$$\frac{dW}{dx} \quad \frac{y}{2} \tag{3}$$

Since

$$x_i = \frac{yH_i}{2B} \tag{4}$$

$$x = \frac{y}{2B} \sum_1^m H_i \tag{5}$$

or

$$y = \frac{2}{\sum_1^m H_i} \cdot \tag{6}$$

Thus for the market curve, $\sum_1^m H_i$ may be replaced by H_t.

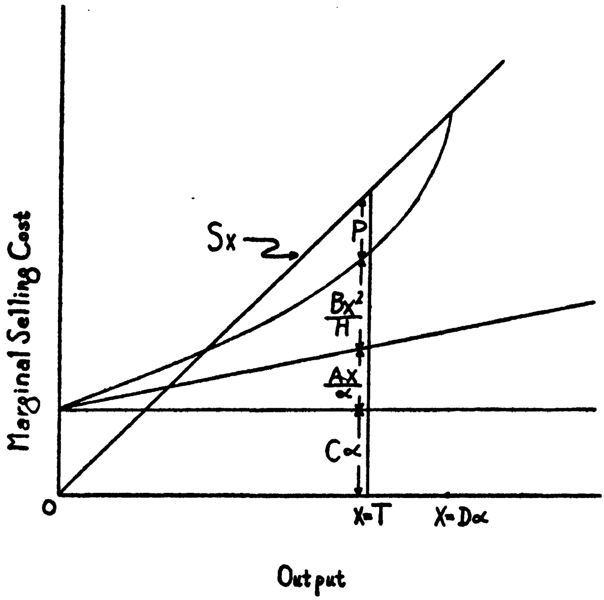
Suppose first that H_t is known. Let S be the selling price. Then profit will be

$$P = Sx - \frac{Ax}{\alpha} - \frac{Bx^2}{H_t} - C\alpha \qquad (\text{for } x \leqq D\alpha). \tag{7}$$

In Chart II the elements into which total receipts are divided are indicated by bands. The maximum production is $D\alpha$, and the maximum profit is realized when $x = T$. In order to make the maximum profit, the business man would set $\partial P/\partial x = 0$ for any given α. Thus,

$$S - \frac{A}{\alpha} - \frac{2Bx}{H_t} = 0 \tag{8}$$

CHART II



or

$$x = \frac{H_t}{2B}\left(S - \frac{A}{\alpha}\right). \tag{9}$$

But profit must also be maximized with respect to α. Thus

$$\frac{\partial P}{\partial \alpha} = \frac{Ax}{\alpha^2} - C = 0. \tag{10}$$

When (10) is substituted into (7),

$$\frac{H_t\left(S - \frac{A}{\alpha}\right)^2}{2B\alpha^2} = C. \tag{11}$$

This is a cubic equation in α and can be solved readily. For example, if $A = 1$, $B = 5$, $C = 4$, $H_t = 10$, $S = 5$; then $\alpha = 1$, $x = 4$, $P = 4$. If the number of production periods is 20, the investment opportunity is worth 80.

But instead of a known H_t there is a probability distribution of possible "H"s. The estimate of H_t from the sample of n is $m\overline{H}' = H'$. The distribution of "H'"s has the same shape as the distribution of sample means. $\sigma_{H'} = m \cdot \sigma_{\bar{H}'}$. The distribution of possible universe sums H

around H' is the same as the distribution of possible "H'"s around the true universe sum.[6]

For any α, let $V(\alpha)$ be the largest value of H whose profit possibilities can be fully exploited. If H is greater than $V(\alpha)$, output must be less than the amount that would equate marginal cost and selling price. For any probability array, the α chosen will balance the extra fixed cost against the opportunity to utilize fully the profit possibilities of the larger values of H.

Enlarging the sample can be expected to reduce the dispersion of the probability distribution of "H"s. There will be less need for a large α, and α will be reduced. When α is reduced, cost is reduced. It is shown below that the profit expectation is increased.

According to equation (9), $X=(S-(A/\alpha))H/2B$. For $V(\alpha)$,

$$D\alpha = \left(S - \frac{A}{\alpha}\right)\frac{V(\alpha)}{2B} \tag{12}$$

or

$$V(\alpha) = \frac{2BD\alpha^2}{(S\alpha - A)} \cdot \tag{13}$$

For any H less than $V(\alpha)$, the output limitation is inoperative. For such an H, the profit expectation per period is found by multiplying the profit equation by $p(H)$, the probability of H. Let P_1 be the result of integrating the profit expectations for all "H"s less than $V(\alpha)$.

$$P_1 = \frac{\left(S - \frac{A}{\alpha}\right)^2}{4B} \cdot \int_{-\infty}^{V(\alpha)} Hp(H)dH - C\alpha \int_{-\infty}^{V(\alpha)} p(H)dH. \tag{14}$$

For an $H \geqq V(\alpha)$, output must be $D\alpha$; maximizing profit requires a larger output, but no larger output is possible. With $x=D\alpha$, multiply each H by its probability, and integrate for all $H \geqq V(\alpha)$. Let P_2 be the result of the integration.

$$P_2 = D\alpha\left(S - \frac{A}{\alpha}\right)\int_{V(\alpha)}^{\infty} p(H)dH - B(D\alpha)^2 \int_{V(\alpha)}^{\infty} \frac{p(H)dH}{H} - C\alpha \int_{V(\alpha)}^{\infty} p(H)dH. \tag{15}$$

The profit expectation for all "H"s is $P=P_1+P_2$ for each period.

[6] Croxton and Cowden, *Applied General Statistics*, p. 314.

$$P = \frac{\left(S - \dfrac{A}{\alpha}\right)^2}{4B}\left[H_t - \int_{V(\alpha)}^{\infty} Hp(H)dH\right]$$
$$+ D(S\alpha - A)\int_{V(\alpha)}^{\infty} p(H)dH$$
$$- B(D\alpha)^2\int_{V(\alpha)}^{\infty}\frac{p(H)dH}{H} - C\alpha. \tag{16}$$

The sample mean, $\overline{H}'$, is an unbiased estimate of the universe mean, so

$$m\overline{H}' = H' \tag{17}$$

is an unbiased estimate of H_t. Thus,

$$P = \frac{\left(S - \dfrac{A}{\alpha}\right)^2}{4B}\left[H' - \int_{V(\alpha)}^{\infty} Hp(H)dH\right]$$
$$+ D(S\alpha - A)\int_{V(\alpha)}^{\infty} p(H)dH$$
$$- B(D\alpha)^2\int_{V(\alpha)}^{\infty}\frac{p(H)dH}{H} - C\alpha. \tag{18}$$

Profit must be differentiated with respect to α, since the sampler is to select the most promising α. The parametric differentiation through $V(\alpha)$ vanishes, leaving

$$\frac{\partial P}{\partial \alpha} = 0 = \frac{A\left(S - \dfrac{A}{\alpha}\right)}{2B\alpha^2}\left[H' - \int_{V(\alpha)}^{\infty} Hp(H)dH\right]$$
$$+ DS\int_{V(\alpha)}^{\infty} p(H)dH - 2D^2\alpha B\int_{V(\alpha)}^{\infty}\frac{p(H)dH}{H} - C. \tag{19}$$

Although the distribution of "H_i"s is not known, the probability distribution of means of samples will probably be nearly normal.[7] Calculations will be based on the assumption of normality.

[7] R. A. Fisher, *Statistical Methods for Research Workers*, 8th Ed., p. 112, "... Even if the original distribution were not exactly normal, that of the mean usually tends to normality, as the size of the sample is increased...."

The standard error[8] of the sum will be

$$m\sigma_{\bar{H}'} = \frac{m\sigma_{H_t}}{\sqrt{n}} \,. \tag{20}$$

Since[9]

$$\sigma_{H_t} = \sigma_{H_s}\sqrt{\frac{n}{n-1}} \tag{21}$$

finally the standard error of the sum is

$$m\sigma_{\bar{H}'} = \frac{m\sigma_s}{\sqrt{n-1}} = \sigma_{H'}. \tag{22}$$

Let

$$z = \frac{H - H'}{\sigma_{H'}} \tag{23}$$

so that

$$H = H' + z\sigma_{H'}. \tag{24}$$

Let

$$t(\alpha) = \frac{V(\alpha) - H'}{\sigma_{H'}} \,. \tag{25}$$

$t(\alpha)$ sets a limit for the number of standard errors by which a possible H can be removed from H', without encountering the output limitation. (19) becomes

$$0 = \frac{A\left(S - \frac{A}{\alpha}\right)}{2B\alpha^2}\left[H' - \int_{z=t}^{\infty}(H' + z\sigma_{H'})p(z)dz\right]$$

$$+ DS\int_{z=t}^{\infty}p(z)dz - 2D^2\alpha B\int_{z=t}^{\infty}\frac{p(z)dz}{H' + z\sigma_{H'}} - C \,.$$

$$= \frac{A\left(S - \frac{A}{\alpha}\right)}{2B\alpha^2}\left[H'\left(1 - \int_{z=t}^{\infty}p(z)dz\right) - \sigma_{H'}\int_{z=t}^{\infty}zp(z)dz\right]$$

[8] Croxton and Cowden, *Ibid.*, p. 307.
[9] Croxton and Cowden, *Ibid.*, p. 311.

$$+ DS \int_{z=t}^{\infty} p(z)dz - 2D^2\alpha B \int_{z=t}^{\infty} \frac{p(z)dz}{H' + z\sigma_{H'}} - C. \tag{26}$$

But $$\int_{z=t}^{\infty} zp(z)dz = \frac{1}{\sqrt{2\pi}} \int_{z=t}^{\infty} ze^{-z^2/2}\,dz = \frac{e^{-t^2/2}}{\sqrt{2\pi}} = p(t). \tag{27}$$

Therefore, (26) becomes

$$0 = \frac{A\left(S - \frac{A}{\alpha}\right)}{2B\alpha^2}\left[H' - \sigma_{H'}p(t)\right]$$

$$+ \left[DS - \frac{A\left(S - \frac{A}{\alpha}\right)H'}{2B\alpha^2}\right] \int_{z=t}^{\infty} p(z)dz$$

$$- 2D^2\alpha B \int_{z=t}^{\infty} \frac{p(z)dz}{H' + z\sigma_{H'}} - C. \tag{28}$$

Apparently (28) cannot be solved analytically. But it can be approximated. For a given α, $\int_{z=t}^{\infty} p(z)dz$ can be found directly from a table of normal curve values, and $\int_{z=t}^{\infty} \frac{p(z)dz}{H' + z\sigma_{H'}}$ can be approximated numercially by Simpson's Rule.[10]

After an α has been selected for trial, $V(\alpha)$ is calculated from equation (13). Next $t(\alpha)$ is found from equation (25). Thus (28) becomes

$$\frac{A\left(S - \frac{A}{\alpha}\right)}{2B\alpha^2}\left[H' - \sigma_{H'}p(t)\right]$$

$$+ \left[DS - \frac{A\left(S - \frac{A}{\alpha}\right)}{2B\alpha^2}\right] \int_{z=[(2BD\alpha^2/S\alpha - A) - 10]/\sigma_{H'}}^{\infty} p(z)dz$$

$$- 2D^2\alpha B \int_{z=[(2BD\alpha^2/S\alpha - A) - 10]/\sigma_{H'}}^{\infty} \frac{p(z)dz}{H' + z\sigma_{H'}}. \tag{29}$$

ILLUSTRATION

Let $A = 1$
$B = S = 5$
$C = D = 4$

[10] Woods, *Advanced Calculus*, 2nd Ed. p. 139.

$m = 100$
$H' = 0.1$
$\sigma_s = 0.03$
$n = 10$

No. of production periods = 20

Then (29) becomes

$$\frac{\left(5 - \frac{1}{\alpha}\right)}{10\alpha^2}[10 - p(t)] - 4 + \left[20 - \frac{\left(5 - \frac{1}{\alpha}\right)}{10\alpha^2}\right]\int_{z=(40\alpha^2/5\alpha-1)-10}^{\infty} p(z)dz - 160\alpha\int_{z=(40\alpha^2/5\alpha-1)-10}^{\infty}\frac{p(z)dz}{10+z} = 0. \tag{30}$$

Successive approximations will select α to any desired degree of accuracy. The optimum value of α must then be substituted into (18), and the profit expectation calculated. Then the profit expectation per period must be multiplied by the number of periods. In the present case $\alpha = 1.0398738$, the profit expectation per period is 3.9732113, and the net worth of the investment opportunity is 79.464226.

The addition of the $(n+1)^{\text{th}}$ item will cause a change in the profit expectation, and the anticipated rise in the profit expectation is the worth of adding the item. Since H' is an unbiased estimate of H_t, the expectation of change in the sample mean with the addition of another item is zero. Thus H' can be used in estimating the new profit expectation. But the sample sigma can be expected to decrease in the ratio $\sqrt{n/n+1}$. Thus when the computations are made in estimating the new profit, $m\sigma_s/\sqrt{n}$ should be used as σ_H'. In the present case, $\sigma_H' = 0.9486832$.

The α corresponding to the new σ_H' is 1.0378347. The new profit expectation per period is thus 3.9762089, and the new investment worth is 0.059952. If adding the $(n+1)^{\text{th}}$ item does not cost more than 0.059952, the item ought to be added.

The procedure can be repeated for each additional item considered, until some item has a net worth less than its cost. Alternately, the computation could be made on the basis of adding items in groups of two or more.

The computational labor required is only moderate. The facts and estimates required are not drastically different from the data commonly used in progressive businesses.

AN INTERPRETATION OF THE QUANTITY INDEX

BY WARREN C. WAITE
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THE SO-CALLED Fisher "ideal" formula for price and quantity indexes has certain advantages in income studies. Among these are that multiplication of the price index by the quantity index computed on an analogous basis results in the value ratio of the two periods under consideration. This relationship is frequently utilized to derive the quantity index by dividing the value ratio by the price index. When this is done, it is not, however, always clear what the process involves other than to result in a number which if used to multiply the price index results in the value ratio.

The following example from an agricultural income study, by separating the quantity index into component parts, shows the effects of changes in the total physical quantities sold as well as changes in the proportions of the products sold. The data are the cash sales by Minnesota farmers of the nineteen principal agricultural products of the state for the period 1911 to 1941. Data at five-year intervals are given rather than the complete series. These data are particularly appropriate to illustrate the problem because of the great change in the character of Minnesota agriculture during the period. The quantity indexes in Table I have been obtained by dividing the value ratio by the price index computed on the basis of the "ideal" formula. It will be observed that the quantity index increases fairly rapidly until 1926, then levels off, and rises during the war.

TABLE I
INDEX OF VALUE OF SALES, PRICES AND QUANTITIES OF NINETEEN PRINCIPAL MINNESOTA AGRICULTURAL PRODUCTS
(1935–1939 = 100)

Year	Value ratio	Price index	Quantity index
1911	52.4	89.7	58.4
1916	75.0	113.0	66.3
1921	79.8	106.5	74.9
1926	135.2	137.1	98.6
1931	79.4	79.5	99.8
1936	106.8	110.0	97.2
1941	150.4	113.1	132.9

Additional computations relative to the quantity of sales are shown in Table II. The actual tonnage of sales results from the reduction of the

various products sold to tons and summing them. The value per ton is derived by dividing the total dollar value of all sales by the actual tonnage sold. In the given year this is $\sum p_1q_1/\sum w_1$ and in the base $\sum p_0q_0/\sum w_0$ where $\sum w_1$ represents the tonnage in the given year and $\sum w_0$ represents the tonnage in the base period. The value per ton is,

TABLE II

ACTUAL TONNAGE AND VALUE PER TON, DEFLATED VALUE PER TON AND RATIOS WITH 1935-1939 EQUAL TO 100 FOR SALES OF NINETEEN PRINCIPAL MINNESOTA AGRICULTURAL PRODUCTS

Year	Actual tonnage of sales (thousands)	Value per ton	Deflated value per ton	Ratio of tonnage 1935–39 = 100	Ratio of deflated value per ton 1935–39 = 100	Product of ratios
1911	4040	$40.37	$44.99	87.9	66.0	58.4
1916	3775	61.76	54.66	82.1	80.8	66.3
1921	4424	56.08	52.66	96.2	77.8	74.9
1926	4555	92.33	67.36	99.1	99.5	98.6
1931	3752	65.82	82.79	81.6	122.3	99.8
1936	4240	78.32	71.33	92.2	105.4	97.2
1941	6073	77.03	68.08	132.1	100.6	132.9

of course, greatly influenced by fluctuations in the level of prices. The values per ton have, in consequence, been adjusted to a uniform level of prices by dividing the actual values per ton for the various years by the index of prices for that year given in Table I. The deflated value per ton in the given year thus becomes:

$$\frac{\dfrac{\sum p_1q_1}{\sum w_1}}{\sqrt{\dfrac{\sum p_1q_0}{\sum p_0q_0} \times \dfrac{\sum p_1q_1}{\sum p_0q_1}}}$$

and for the base period:

$$\frac{\dfrac{\sum p_0q_0}{\sum w_0}}{\sqrt{\dfrac{\sum p_1q_0}{\sum p_0q_0} \times \dfrac{\sum p_1q_1}{\sum p_0q_1}}}$$

but since the index of prices is unity in the base period this may be reduced to $\sum p_0q_0/\sum w_0$. Changes in these deflated values per ton arise

from changes in the composition of the products comprising the ton of sales by the farmer. The upward trend in these values is occasioned by the shift of farmers from products with a relatively low value per ton to products relatively higher in value. In general, it represents more extensive processing on the farm. Instead of selling crops, the farmers of the state have increasingly grown crops to feed livestock with a product resulting which has a higher value per ton. This may be seen by examining the composition of the ratios of deflated ton values in the particular years to the base deflated ton values. The ratio of deflated ton values is:

$$\frac{\dfrac{\dfrac{\sum p_1q_1}{\sum w_1}}{\sqrt{\dfrac{\sum p_1q_0}{\sum p_0q_0} \times \dfrac{\sum p_1q_1}{\sum p_0q_1}}}}{\dfrac{\sum p_0q_0}{\sum w_0}}$$

which may be written as:

$$\frac{\dfrac{\sum w_0}{\sum p_0q_0} \times \dfrac{\sum p_1q_1}{\sum w_1}}{\sqrt{\dfrac{\sum p_1q_0}{\sum p_0q_0} \times \dfrac{\sum p_1q_1}{\sum p_0q_1}}}.$$

Examining this formula and assuming that the individual q_1 and q_0 are equal, it will be apparent that changes in p_1 relative to p_0 do not change the ratio since $\sum w_1$ would equal $\sum w_0$. If, however, the individual p_1 and p_0 are assumed to be equal, changes in q_1 relative to q_0 will change the ratio assuming the $\sum w_1$ remains equal to $\sum w_0$. The index of prices remains unchanged but the numerator of the fraction changes, rising if q_1 is increased where p_1 is above average and decreasing if q_1 is associated with a lower than average p_1.

In the latter portion of Table II, the actual tonnage and deflated value per ton are expressed as ratios with the average of 1935–39 as a base. The product of these ratios is given in the last column of the table and it will be noted that this product corresponds exactly with the quantity indexes of Table I. This must necessarily be true since when the formula above is multiplied by $\sum w_1/\sum w_0$ it reduces to:

$$\frac{\dfrac{\sum p_1q_1}{\sum p_0q_0}}{\sqrt{\dfrac{\sum p_1q_0}{\sum p_0q_0} \times \dfrac{\sum p_1q_1}{\sum p_0q_1}}}$$

which in turn reduces to the Fisher "ideal" quantity index.

The tonnage ratios of our data show comparatively little change throughout the period, except for the increase in 1941. The deflated value per ton, however, increases considerably between 1911 and 1926. The rise in the quantity index for Minnesota cash sales between 1911 and 1926 is, therefore, due to a shift in the kinds of products sold rather than to any actual increase in total tonnage of sales. Between 1926 and 1936, the quantity index remains about the same, an increase in deflated value per ton about offsetting a decline in the total tonnage of products marketed. The increase in 1941 is due almost entirely to an increased total tonnage with little change in the composition of sales.

The quantity index constructed on the basis of the "ideal" formula thus takes into account both changes in physical quantities and the changing proportion of commodities when the relative values of the commodities are in terms of values per unit of weight. Thus the index will rise both when the total weight of products marketed increases with the composition of sales unchanged, and when the total weight of products marketed remains unchanged, or perhaps even declines, but the proportion of products having a higher value in terms of their weight increases.

SOME METHODS FOR THE EVALUATION OF A SUM

By Leo A. Aroian
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In many problems of economics, statistics, insurance, and accounting, it is necessary to find the sum of a large number of variates. This problem, which occurs repeatedly and often entails the loss of valuable time, was first called to my attention by the Metropolitan Life Insurance Company. That organization had used some of the methods without a complete investigation of the basic theory supplied in this article. The main subject of the paper is to show how this problem may be solved by means of existing statistical theory.

The fundamental solution.—Given T variates $x_1, x_2, \cdots, x_T$, we wish to determine $A = \sum_{i=1}^{T} x_i = T\overline{X}_p$, $\overline{X}_p = \sum_{i=1}^{T} x_i/T$. We take a sample of N items by a random process from the T variates and compute the mean of the sample, $\overline{X}_s = \sum_{i=1}^{N} x_i/N$. We estimate the mean of the population by the value of $\overline{X}_s$ and obtain for our estimate of A, $\tilde{A} = T\overline{X}_s$. If this process were repeated for the ${}_TC_N$ samples possible, we would obtain a distribution of $\tilde{A}$. This distribution in general approaches normality as N increases [1]. Naturally when $N = T$, $\tilde{A} = A$. It is assumed that the variates forming the sample are replaced after each drawing of N items. It is well known that $\sigma_{\overline{X}_s} = \dfrac{\sigma_p}{\sqrt{N}}\sqrt{\dfrac{T-N}{T-1}}$, where $\sigma_{\overline{X}_s}$ = standard deviation of the sample means, σ_p = standard deviation of the population [2]. We define $\mathsf{E} = \tilde{A} - A$ and t by the equation $\int_{-t}^{t} y_t dt = 1 - \alpha$, where y_t is the normal probability function and α is the particular level of significance corresponding to t. Obviously, the expected value of E is zero, and $\sigma_{\mathsf{E}} = T\sigma_{\overline{X}_s}$. We are particularly interested in finding N for a predetermined E. Hence $t = \mathsf{E}/\sigma_{\mathsf{E}}$, or approximately

$$tT\sigma_p\sqrt{\frac{1}{N} - \frac{1}{T}} \tag{1}$$

after we replace $T-1$ in the denominator of $\sigma_{\overline{X}_s}$ by T. Solving (1) for N we find

$$N = 1 \div \left\{\left(\frac{\mathsf{E}}{tT\sigma_p}\right)^2 + \frac{1}{T}\right\} = 1 \div \left\{\frac{1}{T}\left(\frac{\mathsf{E}^2}{t^2\sigma_p^2 T} + 1\right)\right\}. \tag{2}$$

From (1) it is evident that E at the α level of significance increases as T and σ_p increase, and decreases as N increases.

In a specific problem E is determined in advance at some arbitrarily chosen level of significance by which t is fixed, T is generally known or found by counting, by measurement, or by weighing. (It is assumed that the variates are entered on cards or listed in columns on a sheet of paper.) The standard deviation for rough exploratory work may be estimated as the range divided by 4, 5, 6, or 7 depending on the nature of the distribution. For a more accurate determination of N we estimate σ_p by use of a small sample. After T, E, σ_p are estimated or known we solve for N by (2). Ordinarily N will be very much less than T. The average confidence belt will be 2E and only in 5 per cent of the cases in the long run of statistical experience, at the 5 per cent level of significance will we construct confidence limits in which A will not lie. The confidence limits will be

$$\tilde{A} \pm tT\sigma_s\sqrt{\frac{1}{N} - \frac{1}{T}} \tag{3}$$

where σ_s is the standard deviation of the sample of N items used as an estimate of σ_p. While $\sigma_p{}^2$ may be estimated more accurately by $\frac{N}{N-1}\,\frac{T-1}{T}\,\sigma_s{}^2$, since N and T are both large, this refinement is of little value here.

Limitations and difficulties.—Some limitations and possible difficulties should be stressed. Care should be taken concerning the approach to normality of E. Estimates may be made of

$$\alpha_{3:\mathrm{E}} = \alpha_{3:\bar{x}_s} = \frac{T-2N}{T-2}\sqrt{\frac{1}{N}\left(\frac{T-1}{T-N}\right)}\alpha_{3:p},$$

or approximately $\alpha_{3:\mathrm{E}} \sim \alpha_{3:p}/\sqrt{N}$, where $\alpha_{3:p}$ is the usual measure of skewness of the population. It is desirable that $|\alpha_{3:\mathrm{E}}| < .1$. An alternative, more troublesome, would be to use the Type III distribution for determination of t [3]. Usually we are generous in the value of N and equation (2) is a guide.

Stratified sampling.—In place of random sampling over the whole population, sometimes it is possible to arrange the variates in order of increasing magnitude or in groups more or less homogeneous. In such instances stratified sampling is decidedly more economical in that a smaller value of N will be needed for the same value of E [4]. We define

$\bar{X}_i$ = mean of the i^{th} stratum, $A = \sum_{i=1}^{r} T_i \bar{X}_i$, r strata in all, where the i^{th} stratum has T_i variates, $T = \sum_{i=1}^{r} T_i$. Let N be the number of individuals in the sample, and let N_i be chosen from each stratum, $N = \sum_{i=1}^{r} N_i$. Let σ_i^2 be the standard deviation of the i^{th} stratum. Let $\tilde{A}$ be our estimate of A, $\tilde{A} = \sum_{i=1}^{r} T_i \bar{X}_{s_i}$, where $\bar{X}_{s_i}$ is the mean of a sample of N_i individuals from the i^{th} stratum. Now it is known that $\tilde{A}$ is normally distributed as N becomes large [4] with variance

$$\sigma_{\tilde{A}}^2 = \sum_{i=1}^{r} T_i^2 \frac{\sigma_i^2}{N_i}\left(\frac{T_i - N_i}{T_i - 1}\right).$$

Our estimate of σ_i^2 will be $\tilde{\sigma}_i^2 = \dfrac{N_i}{N_i - 1} \dfrac{T_i - 1}{T_i} \sigma_{s_i}^2$, where $\sigma_{s_i}^2$ is the variance of a sample from the i^{th} stratum. Since N_i and T_i in many cases are large, we often use the approximation $\tilde{\sigma}_i^2 = \sigma_{s_i}^2$. As in the previous case, we have $\mathsf{E} = \tilde{A} - A$, $\sigma_{\mathsf{E}} = \sigma_{\tilde{A}}$, $t = \mathsf{E}/\sigma_{\mathsf{E}}$, or

$$\frac{\mathsf{E}^2}{t^2} = \sum_{i=1}^{r} T_i^2 \frac{\sigma_i^2}{N_i}\left\{\frac{T_i - N_i}{T_i - 1}\right\} \tag{4}$$

and the only unknowns are the N_i. These values of N_i, the number of individuals in each stratum, may generally be found by trial and error in order that $N = \sum_{i=1}^{r} N_i$ be a minimum, or by calculus, or by finite differences since N_i is a discrete and not a continuous variate. In practice, trial and error seems most expeditious, particularly where an approximation to N is suitable. A measure of skewness, $\alpha_{3:\mathsf{E}}$, may be found in this instance also, but since N is generally large it is not given here. The confidence limits naturally are

$$\tilde{A} \pm t\sigma_{\tilde{A}}. \tag{5}$$

Some examples.—As an example we select the finite population consisting of the squares of the first thousand integers 1, 4, 9, $\cdots$, 1,000,000. Since the items range from one to one million, this example is particularly difficult and is one which would seldom occur in business. The sum of these thousand items is 333,833,500 and T is naturally 1000. The reader may follow the subsequent explanation by consulting a table of squares readily available in many statistical texts. At the 5 per cent level of significance $t = 1.96$, but $t = 2$ is sufficiently accurate for our purposes. Dividing the range, approximately 1,000,000, by 5 we find as our estimate $\sigma_p = 200{,}000$. The choice for E is 2×10^7. If the values for t, σ_p, T and E are substituted into (2), we find that N is 286.

By random sampling methods (Tippett's *Table of Random Sampling Numbers* or any of the other similar tables may be used) 287 items were chosen. We found $\overline{X}_s$ to be 361,900 and $\bar{A} = T\overline{X}_s = 361.9$ millions. The confidence limits at the 5 per cent level of significance from (3) were 342–382 million. We found that a better estimate of σ_p from the sample of 287 was 298,000 and the correct confidence limits of 332–392 million which includes the population value, 333,833,500.

The advantages of stratified sampling, when feasible depending upon arrangement of the material, will be immediately evident in this case. With only 100 items in all, more accurate results are obtained than with the 287 items of the previous case. We divide the variates into 10 strata 1–100,000, 100,001–200,000, etc. We assume $\sigma_i = 30{,}000$, $i = 1, 2, \cdots, 10$. This estimate is approximately the range in a stratum divided by 3, and is quite close. Obviously $T_1 = 316$, $T_2 = 131$, $T_3 = 100$, $T_4 = 85$, $T_5 = 75$, $T_6 = 67$, $T_7 = 62$, $T_8 = 58$, $T_9 = 54$, $T_{10} = 52$; E we take as 6.24×10^6 and for the 5 per cent level of significance $t = 2$. These values of σ_i, T_i, $i = 1, 2, \cdots, 10$, t and E we substitute in (4) and by trial we find $N_1 = 50$, $N_2 = 7$, $N_3 = 7$, $N_4 = 6$, $N_5 = N_6 = N_7 = N_8 = N_9 = N_{10} = 5$, $N = \sum N_i = 100$. After we had chosen a random sample in each stratum, the values of the sample means turned out to be $\overline{X}_{s_1} = 30{,}406$, $\overline{X}_{s_2} = 144{,}940$, $\overline{X}_{s_3} = 250{,}904$, $\overline{X}_{s_4} = 349{,}597$, $\overline{X}_{s_5} = 449{,}350$, $\overline{X}_{s_6} = 542{,}034$, $\overline{X}_{s_7} = 632{,}231$, $\overline{X}_{s_8} = 747{,}490$, $\overline{X}_{s_9} = 844{,}849$, $\overline{X}_{s_{10}} = 941{,}100$ and $\bar{A} = \sum T_i \overline{X}_{s_i} = 330.5$ million with confidence limits by (5) of 324–337 million. More accurate results could be obtained by increasing the number of strata and the size of the sample. It did not seem worth while to calculate the σ_i^2 more accurately than the estimate used. In some applications of stratified sampling we have used less than 1/10 of 1 per cent of the total variates, a real saving in time for the purpose at hand.

Some comments.—Generally in practical work the time spent in using Tippett's tables will not be justified. Instead, a systematic sample is chosen by taking every 10th or every 20th item if the sample is one of 10 per cent or 5 per cent respectively. There will be no dangers unless a cyclical influence is present. A recent paper by the Madows [5] may be consulted concerning the advantages of systematic sampling.

Statistical methods of the type considered in this article promise to be of considerable usefulness in those fields where extended calculations must be made and where a limited accuracy is acceptable. Grouping methods, punched card systems, and the use of a limited number of significant figures do not displace the methods here demonstrated. In fact, sampling may be combined quite efficiently with these other three devices.

I wish to express my appreciation to Professor Marguerite Darkow of Hunter College for reading the manuscript and for making helpful suggestions for its improvement.

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INDUSTRIAL CLASSES IN THE UNITED STATES IN 1940

By Tillman M. Sogge

In an earlier article entitled "Industrial Classes in the United States in 1930," published in this Journal in June 1933, the writer classified the gainful workers in the United States for 1870 to 1930 into industrial classes.[1] This paper brings this classification up to date by adding the data for 1940.

The fact that a new occupational classification was used in the Census of 1940 made the task of regrouping the data for 1940 into this classification somewhat more complicated, but the work was facilitated by the use of the Census report "Comparative Occupation Statistics for the United States, 1870 to 1940" by Dr. Alba M. Edwards.

It was possible to assign all the occupations in the 1940 Census to the classifications used and described in earlier articles in this series covering the period from 1870 to 1930 except the occupational group, "blacksmiths, forgemen and hammermen." This group was reported by the Census in two categories in 1930 (a) "blacksmiths" included in this classification as "unclassified" and (b) "forgemen and hammermen" included as "industrial wage earners." In these tabulations the 87,166 "blacksmiths, forgemen and hammermen" reported in 1940 have been allocated to the two groups "unclassified" and "industrial wage earners" on the basis of the ratios determined from the 1930 distribution when there were 124,373 "blacksmiths" and 23,096 "forgemen and hammermen." From these ratios, of the 87,166 "blacksmiths, forgemen and hammermen" in 1940, 84 per cent or 73,219 have been allocated to the "unclassified" group and 16 per cent or 13,947 are included as "industrial wage earners."

Even though the classification remains basically the same the change from the concept of "gainful worker" used in earlier Census periods to that of "labor force," used in 1940 should be kept in mind in making comparisons. The gainful worker data include all persons 10 years old and over reported as having a gainful occupation, regardless of their activity at the time of the Census. The statistics for 1940, however, include only those persons 14 years old and over who were in the experienced labor force during the week of March 24 to 30, 1940. The experi-

[1] These data for the years 1870 through 1920 were first presented by Professor Alvin H. Hansen in the two following articles which appeared in this Journal. (1) "Industrial Class Alignments in the United States," published in December 1920, and (2) "Industrial Classes in the United States in 1920," published in December 1922.

TABLE I
INDUSTRIAL CLASSES

	1870	1880	1890	1900	1910	1920	1930	1940*
Farm laborers	2,885,996	3,323,876	3,004,061	4,410,877	6,143,998	4,178,637	4,392,764	3,505,275
Farmers	3,000,229	4,282,074	5,370,181	5,770,738	6,229,161	6,463,708	6,079,234	5,328,049
Proprietors and officials	581,378	807,049	1,347,329	1,811,715	2,879,023	3,168,418	4,270,856	4,197,207
Professional	414,708	666,338	1,114,507	1,565,686	2,074,792	2,760,190	3,845,559	4,454,381
Lower salaried	309,413	529,473	965,852	1,329,928	2,393,620	3,985,306	7,116,814	8,071,201
Servants	975,734	1,075,655	1,454,791	1,453,677	1,572,225	1,270,946	1,999,133	2,840,021
Industrial wage earners	3,328,351	5,286,829	7,360,442	10,263,569	14,556,979	17,648,072	18,512,640	19,957,220
Unclassified	1,010,114	1,420,795	2,118,498	2,467,043	2,317,538	2,138,971	2,612,920	2,383,930
Total	12,505,923	17,392,099	22,735,661	29,073,233	38,167,336	41,614,248	48,829,920	50,737,284

TABLE II
INDUSTRIAL CLASSES (per cent)

	1870	1880	1890	1900	1910	1920	1930	1940*
Farm laborers	23.1	19.1	13.2	15.2	16.1	10.0	9.0	6.9
Farmers	24.0	24.6	23.6	19.8	16.3	15.5	12.4	10.5
Proprietors and officials	4.6	4.6	5.9	6.2	7.5	7.6	8.7	8.3
Professional	3.3	3.8	4.9	5.4	5.4	6.6	7.9	8.8
Lower salaried	2.5	3.0	4.3	4.6	6.3	9.6	14.6	15.9
Servants	7.8	6.2	6.4	5.0	4.1	3.1	4.1	5.6
Industrial wage earners	26.6	30.4	32.4	35.3	38.2	42.4	37.9	39.3
Unclassified	8.1	8.2	9.3	8.5	6.0	5.1	5.4	4.7

* These figures do not include 1,282,739 experienced persons in the labor force for whom occupations were not reported.

enced labor force consisted of (a) employed persons (except those on public emergency work), (b) persons on public emergency work, and (c) experienced workers seeking work, that is, persons without work of any sort who were actively seeking work during the Census week, and who had previously worked full time for one month or more. Certain classes of persons, such as retired workers, some inmates of institutions, recently incapacitated workers, and seasonal workers neither working nor seeking work at the time of the Census, were frequently included among gainful workers in 1930 and earlier years but in general such persons were not in the 1940 labor force. On the other hand, the 1940 labor force includes certain persons who would not have been counted as gainful workers in earlier Censuses.

Tables I and II indicate the number and percentage of gainful workers falling in each of the industrial classes for each ten year period from 1870 to 1930 and of the experienced labor force in 1940.

As the 1940 data in Tables I and II relate to persons 14 years of age and over whereas the 1930 figures include gainful workers 10 years of age and over, a special computation was made to determine the effect of this change. This computation provided a distribution of the 1930 gainful workers 14 years and over. This indicated that of the 235,328 gainful workers in 1930 who were less than fourteen years of age 205,563 were farm laborers, 51 were proprietors and officials, 974 were professional, 1,295 were lower salaried, 5,972 were servants, 10,112 were industrial wage earners, and 11,361 were included in the unclassified group. These relatively small numbers had only a minor influence upon the percentage distribution in Table II. A new percentage distribution based upon gainful workers 14 years and over led to the following changes in the percentages for 1930, −.4 for farm laborers, +.1 for farmers, +.1 for proprietors and officials, +.2 for industrial wage earners. All other percentages remained unchanged.

NOTES AND DISCUSSIONS

THE SOCIAL INSURANCE MOVEMENT

Under this title there appeared in the September 1943 issue of this JOURNAL an interesting article by R. Clyde White, giving a short but very good summary of the development of social insurance legislation. There is little to criticize except to call attention to some errors in the dates of Table I. This is even more important because in the publications of the International Labour Organization on Social Insurance (Series M) wrong dates have sometimes been given.

One of the first compulsory social insurance laws of the world, though very different from those of today, was that promulgated in 1854 for the miners of Austria covering sickness, invalidity, old age and survivors. Under this law the proprietors of mines were obliged to establish an insurance office for their subordinates or to join an already existing office. That law was replaced by a new one in 1889 which brought important improvements. In Germany in 1883 a law was introduced not for social reform as in the case of Austria but for mere reasons of political authority, which established sickness insurance not for a single professional group alone but still for a limited circle. This was followed in 1884 by a compulsory accident insurance law, the first draft of which was presented to the Reichstag in 1881. A law which appeared in 1878 on "socialist endeavors, dangerous to the common weal" created a kind of exceptional law against Socialists. This law was directed against quite a class of the population.

According to today's thought, social insurance ought to improve the condition of the poor classes of the population and to bring about a rational medical treatment. It provides for the family of the insured, that is his wife and children, and hence should influence favorably the coming generation and make children healthy and more capable of resisting illness. Social insurance legislation also is intended to improve family living, because the insured wins security in case of loss of income by sickness, etc. No one today calls social insurance "socialistic legislation." All states have an interest in the introduction of new or improvement of existing laws, though in imperialistic states among other aims there is that of the improvement of military potential. Nothing now remains of the erroneous ideas of Bismarck, that this type of legislation is merely socialistic. Indeed, many of the new social insurance laws no longer refer to workers or employees but to independent professions (artisans, representatives of free professions, etc.).

The draft of the Austrian bill referring to workers' compulsory accident insurance of the year 1881 became law at the end of 1887 after various alterations, and was published in No. 1 of the Law Advertiser of the Reich (Reichsgesetzblatt) of the year 1888. The sickness insurance law which had been considered by Parliament as early as 1885 was dated early in 1888 and

was published in the Reichsgesetzblatt, No. 33, ex 1888. The first law instituting compulsory insurance for employees (it also stems from Austria and not from Germany as has often been erroneously stated) was adopted at the end of 1906 and covered old age and survivors but not invalidity. Only five years later a similar law was adopted in Germany (1911). The first sickness insurance law in Hungary was published in 1891 and in Serbia in 1910. After the breakdown of the monarchy in 1918 the validity of the earlier laws has been maintained in the successor states as long as these will have made an own arrangement for their whole territory (Austria, Czechoslovakia, Italy, Poland, Roumania and Yugoslavia), so that in some of these countries different laws have been valuable so far.

As a supplementary remark it may be mentioned that social insurance legislation had already begun in 1890 in Iceland. This was not mentioned in Dr. White's table.

As to Venezuela the following may be stated: The bill of 1939 that purported to be able to cover sickness, invalidity, accident, old age and maternity at a premium of only 8 per cent was not accepted by Parliament, and the law of mid-1940 covers only accident, sickness and maternity. In article II there is stated expressly that old age, invalidity, survivors and unemployment will only be covered later by special laws. The statements mentioned should be changed correspondingly in Dr. White's first table.

ERIC MÍCHALUP

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II

Dr. Míchalup has raised several questions of fact concerning my article in the September 1943 number of this JOURNAL. I should like to comment on some of these.

It is quite correct to say that social insurance did not originate with Prince Bismarck and with the enactment of the German sickness insurance law of 1883. The use of the insurance principle in a mutual aid group was very common among the medieval craft guilds, but this was not government insurance nor general coverage in a geographical area or political subdivision. It was voluntary mutual aid. European miners have collected funds among themselves, sometimes supplemented by employers or some governmental unit, to pay the costs of sickness, accident or old age for hundreds of years. This was not social insurance in the sense in which I used the phrase nor in the sense in which most writers on social insurance use the term, although historically this kind of mutual aid may be regarded as an antecedent of the type of national legislation represented by the German sickness insurance law of 1883. There is fairly general agreement among writers on social insurance that 1883 is the year in which modern social insurance had its beginning, and 1884 when the German accident insurance law was enacted is generally

accepted as the beginning of accident insurance (or workmen's compensation in English speaking countries).

Dr. Michalup takes exception to the dates which I assigned to the national insurance laws of some of the countries which prior to 1918 were constituent parts of the German Empire and the Austro-Hungarian Empire. Among these countries are Hungary, Serbia, Czechoslovakia and Poland. Some social insurance measures were operative in these countries prior to 1918, but as sovereign states these countries did not exist for the most part until after World War I, and I was concerned with their legislation as sovereign states. Iceland did have social insurance services, but it was taken by this writer as a constituent part of Denmark.

I accept Dr. Michalup's correction regarding the effective parts of the social insurance laws of Venezuela. The law of 1940, Part I, 2 says, "Special Acts shall be enacted to extend compulsory social insurance to the risks of old age, invalidity, death and unemployment." For some reason the "special acts" did not get adopted, and I believe they are still in deferment.

It should be recognized that, like most historical matters, there is often good ground for a difference of opinion about matters of detail as well as matters of interpretation in social insurance. Dr. Michalup is entitled to his opinion about some of these things, concerning which I differ, but I believe we are agreed as to the general fact of the steady and rapid growth of social insurance legislation throughout the world.

R. CLYDE WHITE

Western Reserve University

A NOTE TO "ON THE SUMMATION OF PROGRESSIONS USEFUL IN TIME SERIES ANALYSIS"

The author regrets to say that the following errors have crept into the above article, this JOURNAL, September, 1944, on page 387.

In series (3) and (4) the general terms, which appear as $(2x-n+1)^r$ and $\left(\frac{2x-n+1}{2}\right)^r$, should have been $(2x-n-1)^r$ and $\left(\frac{2x-n-1}{2}\right)^r$. Also the last term in the expansion of series (4), which was given as $\left(\frac{n-1}{3}\right)^r$, should have been $\left(\frac{n-1}{2}\right)^r$.

JOSEPH A. PIERCE

Atlanta University

BOOK REVIEWS

Glenn E. McLaughlin, *Review Editor*

The Design of Experiments, by R. A. Fisher, Third Edition. London: Oliver and Boyd, Ltd. 1942. xi, 236 pp. 12/6.

The three editions of this book are virtually the same, the changes consisting of a small amount of additional material in successive editions. Comprehensive and informative reviews of the earlier editions by Hotelling describing the content of the book and giving an exposition of some of the ideas were published in this Journal in December, 1935, pp. 771–772, and in September, 1937, pp. 580–582. The new material in the present edition consists of Sections 45.1 and 45.2 in the chapter on confounding, which deals with a method of subclassification of the observations in such a way that differences on important variables may be made on reasonably homogeneous groups, while less important differences will be incorporated in or "confounded" with the group differences and thus be indistinguishable.

The book contains a number of ideas of great importance to individuals engaged in experimental work in the field of science. The fundamental issues presented in the first two chapters should be reviewed in detail by every scientific worker. The mathematical concepts and methods used by the author in his approach to experimental material have all of the beauty that one so often finds in illustrations of the art of pure mathematics. Considered, however, as an expression of applied mathematics, they seem to the reviewer to place too much stress on refinements that lead to the greatest efficiency in the analysis when the conclusions that are to be drawn from it are very strongly influenced by assumptions and judgments on which the analysis is based.

One important assumption of this character Fisher calls attention to on page 179 when he states that the methodology of the preceding seven chapters is subject to the assumption: "In this kind of hypothesis all discrepancies classified as error, and not eliminated from our comparisons by equalization or regression, are due to variation, in the material examined, following the normal law of errors with a definite and constant, but unknown, variance." The effects of this assumption may be and very often are far greater than those resulting from the differences between the more exact methods developed by Fisher and the approximate and simple methods that are in fairly common practice.

The judgment issue involved in statistical tests is the one which Fisher brings out in his discussion on page 13 where he states "It is open to the experimenter to be more or less exacting in respect of the smallness of the probability he would require before he would be willing to admit that his observations have demonstrated a positive result." When, as scientists, we are faced with the fact that the 5 per cent level of significance is nothing but

a "convenient convention," methods which classify our results with a high degree of accuracy relative to this conventional limit seem over-elaborate.

A good illustration of this issue is the example which Fisher discusses on pages 137–149, where he considers the result of an experiment carried out at Rothamsted in 1927. The mathematics of this analysis is beautiful but when one looks at the scientific conclusions as summarized in Section 53 one realizes that they do not differ in any degree from those that would have been reached by the conventional approximations to this exact analysis. In addition to that the analysis seems to this reviewer to completely omit one of the important scientific issues involved and that is that experiments of this type certainly fall into the realm of dosage reactions and although Fisher has used quantities (0), (1), and (2), the analysis pays no attention to where these quantities fall on a dosage scale. Table 23 on page 147 has a very strong suggestion that quantity (2) which is the level at which he draws his final conclusion is at entirely different relative positions on the dosage curve for the chemicals under consideration.

One could wish that the author had devoted more attention to the methods by which the scientist may check the effects of some of the necessary assumptions and to the ways in which we may justify "confounding," not by the internal evidence of the experiment at hand, but by experiments designed for this purpose. Both of these are of great importance in the design of experiments and fall very definitely within the field of responsibility of the mathematical statistician.

LOWELL J. REED

The Johns Hopkins University

Statistical Tables for Biological, Agricultural and Medical Research, by R. A. Fisher and F. Yates, Second Edition. London: Oliver and Boyd, Ltd. 1943. viii, 98 pp. 13/6.

The first edition of these tables, published in 1938, was reviewed in this JOURNAL by Snedecor, March, 1939, pp. 206–207. This review summarized the coverage of the tables, pointed out some of the unusual features, and predicted that they would prove a valuable aid to the practicing statistician. The soundness of this prediction is indicated by the appearance of the second edition five years later.

The second edition includes four new tables numbered V-1, V-2, VIII-1, and VIII-2, the numbering of the tables contained in the previous edition being unaltered. Table XVII, which gives combinatorial solutions, has been extended. The errata discovered in the first edition have been corrected and a partial list of these is given, p. viii, for the convenience of users of this earlier edition.

Tables V-1 and V-2 pertain to Behrens' tests of significance between two means, for the case where the means have sampling distributions with different values of the variance. Table V-1 deals with the distribution of differences resulting from two Student distributions with n_1 and n_2 degrees of free-

dom, Table V-2 with the distribution resulting from a normal component of known variance and a Student distribution.

Table VIII-1 deals with estimates of the probability of a single event, when the event has been observed to happen a out of N times.

Table VIII-2 aids in the determination of density of organisms from the dilution method if the dilution ratio is 2, 4, or 10.

All of these new tables contain a serious defect which detracts from their usefulness. This is a lack of clear and complete labelling of the argument and tabulated values. For example, Table V-1 is titled "Significance of Difference Between Two Means." The horizontal axis is tabulated in degrees at 15° intervals from 0° to 90° and is not labelled. The vertical axis is given in two columns, the first of which is headed "5 per cent points" followed by values of n_2. The second column is labelled n_1. The tabulated material which consists of 5 per cent points, is unlabelled. A paragraph in the introduction which pertains to this table fails to state explicitly what the table does contain. This criticism is not confined to the new tables, but applies to several of the original tables. Thus, the argument is not labelled in several of the original tables and in some of the others, including the first one of the normal distribution, the content of the table is not stated except indirectly in a footnote.

Once their content is ascertained the tables become a very useful part of our modern statistical equipment and the added material in this new edition will increase their range of application.

LOWELL J. REED

The Johns Hopkins University

Vital Statistics Rates in the United States: 1900–1940, by Forrest E. Linder and Robert D. Grove under the supervision of Halbert L. Dunn, M.D. Bureau of the Census, Washington: Superintendent of Documents. 1943. vii, 1051 pp. $1.75.

The vital statistician in particular and the student of social phenomena in general will have many occasions to turn to this very useful volume. During the 41 years covered by the book many changes in public health thinking have taken place and much progress has been made. The rates presented in this volume provide an excellent review of vital trends during this developmental period and furnish raw material necessary to any intelligent discussion of current and future medical, social, and economic problems.

The book contains 43 tables concerned with mortality rates, 9 with natality rates, and 17 with the population data on which the rates are based. Crude rates are presented first and then rates specific for age, sex, color, nativity, month of occurrence and cause of death. Tables showing the trend of the rates over the 41 year period come first followed by others showing, for 1940 only, the rates broken down for small areas. In addition there are two general summary tables for 1940 bringing together the material for each

of the three classes of data. Most of the rates are on a place of occurrence basis since only in recent years have data on a residence basis become available.

Use of the volume is considerably facilitated by the inclusion of tabular indices to the tables which enable the user to tell at a glance which tables contain the particular items he is interested in and whether or not they are cross-classified in the manner desired. The tabular index to the population tables is particularly valuable since it makes clear the population bases which may be used for computing the number of births or deaths contributing to any rate in the volume.

In addition to the tables there are five chapters of text covering 119 pages. Chapter I is introductory. Chapters II and III are concerned with the classification, tabulation. definition, and interpretation of vital statistics data. Chapter IV is a detailed discussion of adjusted rates. Although Chapters II, III, and IV are not requisite to the use of the tables, together with the list of references at the end of each chapter, they constitute an excellent introductory text for the student of vital statistics and will probably be used as such. Chapter V, Description and Explanation of Tables, is absolutely essential to the proper interpretation of data in the tables and should be carefully studied by users of the volume.

Original plans for the volume, which were curtailed because of the war, included the presentation of adjusted rates and other indices. It is hoped that eventually these plans will be realized. In the meantime, as the authors point out, "the most essential parts of such a volume are specific rates. . . . With these 'raw materials' the biostatistician can proceed with his own analyses and studies." Certainly the volume will be one of the most referred to in the field.

PAUL M. DENSEN

Vanderbilt University,
School of Medicine

Statistical Analysis in Biology, by K. Mather. New York: Interscience Publishers, Inc. 1943. 247 pp. $4.50.

The author is head of the Genetics Department at the John Innes Institution, London, and has worked close to R. A. Fisher for a number of years. He presents, from the viewpoint of a biologist, most of the techniques developed in Fisher's *Statistical Methods for Research Workers* and some of those in Fisher's *Design of Experiments*. The exposition is lucid.

The distinction between the sample and the population and the concept of a test of significance are introduced at the beginning of the book, both with reference to the binomial distribution. The author then proceeds to a discussion of the normal and Poisson distributions and of the t, z, and χ^2 distributions. An introduction to the analysis of variance is followed by a chapter on the partition of degrees of freedom into single components. Chapter VII, on the planning of experiments, lays stress on factorial experi-

ments and describes randomized blocks, the Latin square, and the confounded $2\times2\times2$ factorial arrangements.

The ensuing section on regression theory is devoted to simple, multiple, and polynomial regressions and the analysis of covariance, followed by an example of the use of discriminant functions. Inter- and intra-class correlations are described rather briefly. The analysis of frequency data and more particularly of contingency tables is developed in considerable detail, presumably in view of its usefulness in tests of Mendelian inheritance. Included in this section are the rules for the sub-division of the "goodness of fit" χ^2 into single degreees of freedom—seldom given in text books. The book ends with an account of the method of maximum likelihood and of the elements of Fisher's theory of estimation.

Calculus is introduced only insofar as necessary in dealing with the method of maximum likelihood and the method of least squares. The rather free use of algebra in the later sections of the book is defended by the author, though it is doubtful whether some of the algebraic portions, e.g. the proof that one form of χ^2 gives results identical with another form, really contribute much to the reader's understanding of the subject.

The defects of the book arise mainly from the limited range of the author's reading in statistical literature, and his limited knowledge of statistical theory. Thus, as evidence that non-normality does not vitiate the analysis of variance tests, it is stated (p. 35) that "Actual data have been analysed by Eden and Yates and the insignificance of these errors has been fully demonstrated." In fact, the data analyzed by Eden and Yates are only slightly non-normal, as Neyman has pointed out, while the question of non-normality has been the subject of at least fifteen papers which are ignored by the author. Fisher's z-distribution is said (p. 45) to be "independent of the two true standard deviations" which is incorrect unless the true standard deviations are equal. The pooling of mean squares which are not significantly different is highly recommended (p. 78), without a realization that this practice renders the use of a subsequent z-test invalid, at least to some extent. The discussion (p. 79) of a group of barley experiments where year and place interactions enter is much over-simplified, though the complexities involved in a realistic analysis of these same data have been investigated by Yates and Cochran. The recommendation (p. 175) that χ^2 should never be used where any class frequency is less than 5 is over-cautious in view of recent work on this problem, and is not helpful, since the reader is not told what to do when a class frequency is less than 5. Actually the author breaks his own rule without comment (p. 191), where a χ^2 analysis is carried through with one frequency as low as 2. Similarly, the author's resolve to use Greek letters for population parameters and Latin letters for sample estimates is not well kept; thus p is used throughout for the parameter of a binomial distribution and λ is used for both population and sample weights in discriminant functions (p. 157). On p. 205 occurs the curious statement that Fisher's theory of estimation is independent of the theory of probability. In the glossary (p. 234), bias is described as "the average error of an estimate." The absence

of an adequate discussion of transformations is regrettable. Too many significant figures are carried in almost all computations.

W. G. COCHRAN

Princeton University

The Statistical Study of Literary Vocabulary, by G. Udny Yule. New York: The Macmillan Company. 1944. ix, 306 pp. $6.00.

This book is the outgrowth of a study started by the author to determine, by a consideration of vocabularies, whether *De Imitatione Christi* was written by Thomas à Kempis or by someone else. It soon became apparent to him that known statistical methods were inadequate to cope with the problem. Consequently he set about to devise general statistical procedures by means of which hypotheses regarding authorship and literary style could be objectively tested.

If the words employed in a certain writing are classified into the number used once, the number used twice, and so on, there is obtained a word-distribution, somewhat comparable to a distribution of accidents, which the Poisson exponential distribution has been used to describe. (Obviously this is also true for a sample from the writing or for words of a certain type, e.g. nouns or adjectives.) A word-distribution, however, differs from a distribution of accidents in that time is not specifically involved and that the distribution is decapitated, since the number of words that have not met with the "accident" of being used is unknown. Yule derives a characteristic for the decapitated distribution which is independent of sample size. By means of this characteristic he compares and contrasts word-distributions from different works of the same author and such distributions from works of different authors. He also discusses the alphabetical distribution of English vocabulary—his study of *De Imitatione Christi* is, of course, a study of the vocabulary of the Latin original—and makes an etymological analysis of the writings of certain English authors.

In his conclusion Yule modestly emphasizes the incompleteness of his work and stresses the need for a study of adjectives and verbs—his own study is concerned principally with nouns. He states that the methods developed are applicable to the study of languages-in-use and expresses the hope that they will not be used solely for the study of controversial matters. He suggests further problems both for the student of language and literature and for the theoretical statistician. Although I am not familiar with the methods used by the former, I am confident that he will do well to consult the book under review. It is written by a competent authority on general statistical methods and is sure to contain ideas which will prove helpful. The theoretical statistician will find it interesting and stimulating reading.

PAUL R. RIDER

Washington University, St. Louis

Readings in Business Cycle Theory, selected by a Committee of the American Economic Association. Philadelphia: The Blakiston Company. 1944. xvi, 494 pp. $3.75.

This collection of readings is the second of a series, the first having dealt with the social control of industry. Selections for this second volume were made by a special committee of the American Economic Association under the chairmanship of Professor Gottfried Haberler. Of the 21 readings reproduced, all but two are taken from economic and statistical journals, although several of the articles are available as reprints in other books.

The purpose of the volume as noted in the preface is to bring together under one cover "the most useful periodical literature" on business cycle theory. The two excerpts from books (one by Wesley C. Mitchell in *Business Cycles and Unemployment* and the other by Frederick A. Hayek in *Profits, Interest and Investment*) were chosen doubtless because the committee felt that no articles in periodical publications would fill so well the need for chapters on general description of business cycles and on price expectations, monetary disturbances and maladjustments. This digression suggests one of the characteristics of the volume, which is the fitting of short essays on specialized phases of business cycles so far as possible into an analytical framework of theory. Since the articles were not written to a predetermined outline, some duplications and contradictions are to be found, which, however, have been held to a minimum. Any disadvantages which arise from this source are more than counterbalanced by the advantages of a systematic presentation of the gems of business cycle literature. It scarcely seems possible that any single analyst or group of analysts writing anew to the same outline could produce a work of equal richness of thought.

Nevertheless, the collection of readings, in the reviewer's opinion, can hardly qualify as a general treatise on business cycle theory, Too much stress is placed on financial overlay and prices as factors in business cycles and too little on such aspects as psychological and physical factors which produce variable reactions in the course of time and which may be at the root of at least part of the financial and price variations. Can it be denied that the psychological and physical derangements of the present war period, for example, will exercise a substantial, if not a controlling, influence on business cycles yet to come?

The selection committee appears to have viewed the problem through the special glasses so typical of present-day business cycle theorists. This concentration of attention reminds one of the young farmer who at the outset of his career purchased a team of white horses of which he became exceedingly proud. Thereupon he observed that he grew keenly interested in horses—provided that they were white. Although the reviewer has no strong feeling against the "white horses" of business cycle theory, he does believe that the blacks, browns and sorrels should be given more attention.

The same limitation of scope does not apply to an excellent, 42-page, classified bibliography of business cycle articles supplied by Professor Harold

M. Somers. The classification in this bibliography parallels that in the body of the book, but contains in addition extensive references to psychological influences; technology; innovations; depreciation; inventories; wages, costs and prices in relation to output and employment; monopolistic factors; special fluctuations in agriculture and building; and the influence of wars and population growth.

WILBERT G. FRITZ

War Production Board

Economic Fluctuations in the United States, by Edwin Frickey. Cambridge: Harvard University Press. Harvard Economic Studies 173. 1942. xxi, 375 pp. $5.00.

Professor Frickey sets himself the task of describing the secular and cyclical movements of major composite series for the period 1866 to 1914. His work is important for two principal reasons. The decomposition of series into cyclical and secular movements is performed meticulously by methods which are as objective as possible. The pattern of cyclical movement is found to be strikingly similar for various processes of change and to be pervasive through the economy.

The conventional method of fitting and eliminating a trend does not face the question as to the proper method of decomposition. The length of the cycle of pig iron production, for instance, varies more than 10-fold depending on the trend fitted and period used. Frickey's study assumes as evident only the presence of seasonal and irregular fluctuations. Taking the 13 composite series on which data are available for the period, cyclical fluctuations are discovered which are found by several methods to be most uniform as relative fluctuations. Accordingly, period to period changes are investigated in terms of link relatives rather than first differences. To facilitate the comparison of the short-run fluctuations, long period drift is reduced by expressing each link relative series in deviations from its average link relative; each series is then divided by its dispersion measure; time adjustment is made to correct for lagging in 7 of the series. A link relative standard pattern is developed by averaging the 7 middle link relatives in the array. These computations are carried out for quarterly, annual, two, three, six, and nine year periods. The short-period fluctuation remains strikingly similar for the various series until six-year periods are employed.

The standard pattern derived from the 13 series is compared with carefully developed measures of total production, manufacturing production, agricultural crop production, transportation and communication, trade, manufacturing employment, and commodity prices. All of these cyclical patterns are found to be surprisingly similar to the standard pattern. This evidence, the reviewer believes, greatly strengthens the case for pervasiveness of the general business cycle in the period studied. The showing demonstrates the interdependence of cycles in different industries and processes.

The uniformity of the cyclical pattern is the key to Frickey's procedure in decomposing time series. The production index, chained from link relatives, is divided into 7 cyclical sub-periods measured from the base line, and decomposition is studied separately for each cyclical period. The cyclical movement in production in each of the cyclical periods is compared with 12 of the other series selected for the purpose. Two methods are employed in separating the time series elements. First, the logarithmic parabola is established as an appropriate trend for the production index partly by a study of logarithmic differences. The production index is used as a "denotative" series in decomposing other series—the cycle is eliminated by dividing by the form established by the cycle in production. Thereby, trend indications are established. Second, a method of gradual attenuation is employed. As a first approximation, the standard pattern is employed to isolate approximate trend indications separately by sub-periods. By use of the trend indications so developed the standard pattern is revised which in turn is again used to isolate trend indications, etc.

Finally, on the basis of the analysis so described, and the employment of a minimum amount of discretionary judgment, trends are fitted mathematically to a modified series derived from the most important data available for the period.

No sketchy review of Frickey's procedures can possibly portray the care with which alternative possibilities are examined, second demonstrations are developed independently on various questions raised, and controls are set up to check against bias. No student can fail to be impressed by the care with which the study was made.

Frickey's results do not replace conventional trend-cycle separation, at least for the present. His results cannot assuredly be given wider application, especially when individual industries are studied, and in any case extensive and tedious analysis would be required. The fact that his conclusions tend to verify those arrived at by the less objective conventional time-series decomposition would appear to give confidence in results obtained from these conventional methods when they are employed with care.

The conclusion that the series studied in the 50-year period demonstrates one pervasive cyclical pattern and smooth secular movements for composite series is of first importance. It weakens the case for a series of concurrent cycles in the United States. (It, however throws no light on very long cycles such as the "Kondratieff," because only 50 years are covered.) This conclusion would be immediately much more useful if Frickey had developed a studied comparison between the cyclical periods he established and the greater number often read into three of his sub-periods (as shown in parenthesis): 1866–78 (2), 1885–96 (4), 1896–1904 (2).

Minor conclusions Professor Frickey has developed are as important as the major ones reached in many books. The cyclical movement in the series studied shows a close approximation to a relative relationship to the secular trend. As a corollary logarithmic differences are effectively employed as a technique in studying trends. Secular trends for separate industries appear

to be more complicated than they are often assumed. In contrast, the secular trend of the production index is a simple logarithmic equation, simpler than the trends for most economic processes.

Frickey's book is a report on research and he has not deviated from careful reporting. Unfortunately the style is somewhat tiring. The book is recommended to all social students who draw conclusions on general economic change, and who does not? No direct applications are made to present day economic changes but those who appeal to history should understand Frickey's findings.

Elmer C. Bratt

Washington, D. C.

Postwar Monetary Plans and Other Essays, by John H. Williams. New York: Alfred A. Knopf. 1944. viii, 297 pp. $2.50.

Dean Williams renders a distinct service to students of monetary policy by reprinting here eleven of his papers on different phases of the subject originally published in various journals from 1929 to 1944. Part I contains the three most recent papers, dealing specifically with the Keynes and White plans and related problems. Part II deals with deficit spending and the relation of fiscal and monetary policy. Part III discusses international trade and the gold standard against the background of the depression years.

Within each group the papers are arranged chronologically to show the development of the author's thought. He examines the classical theories and the contemporary ones and in successive papers shows where they fail to satisfy his thinking and suggests modifications of theory and practice. He is never dogmatic, never sure that a certain theory is correct or a certain policy perfect; but he gets down to the fundamental factors that must be considered.

There is not space here to consider the stimulating papers in Parts II and III, for those in Part I on "Postwar Monetary Plans' are naturally of the greatest current interest. Dean Williams amplifies them with a 22-page introduction, written before the Bretton Woods Conference, but still pertinent. He discusses various details, such as the necessity of continuing exchange controls during the transition period for all and longer for the "younger agricultural countries"; the need for allowing for economic growth and the business cycle, neither of which figured in the classical theory of the gold standard; the problems raised by the dominant position of the United States in the world economy, with other countries likely to want more dollars than we want of their currencies; the probable desirability of considerable adjustments of exchange rates even after the transition period; and numerous other matters. On the more fundamental plane he feels it would have been better to tackle first the problems of relief, reconstruction, and war balances, "counting primarily upon exchange controls to keep currencies stable until these problems had been solved." And for the long run:

. . . I come back always to the conclusion that the problem of international monetary stability is primarily that of maintaining a state of proper economic health in the leading countries; and this is the only workable answer to the whole conflict between internal and external monetary stability, about which discussions of the gold standard for years revolved.

DICKSON H. LEAVENS

Cowles Commission for Research in Economics

Canada's Financial System in War, by Benjamin H. Higgins. New York: National Bureau of Economic Research. 1944. 82 pp. 50 cents.

The author, a professor of economics at McGill University and a member of the National Bureau's Research Staff, begins his study with a broad survey of the policies which enabled Canada to increase federal expenditures from one-tenth of gross national product in 1939 to one-half in 1943 with a minimum of inflation. He outlines the main wartime developments in the Dominion's tax system, describes concisely the direct controls over prices and production which have provided the essential complements of fiscal measures, and notes the character and extent of the industrial expansion which has made it possible for the war to be financed without curtailing civilian consumption except in highly durable consumer's goods. This section provides a useful summary of the basic elements of Canada's war economy.

The two succeeding sections extend the scope of the study so as to justify its title. Dealing mainly with the borrowing side of war finance, they describe the machinery through which government bonds were sold, show into whose hands they went, and review the effects of wartime operations and participation in war loan issues on the balance sheet items of the banks and the investment portfolios of life insurance companies. But they consider also such matters as the influence of the war on business profits, the working capital of corporations, and retail credit, and the investment problems the insurance companies will face after the war. The sections are accordingly not free from discursiveness, and the reader, left at points without a clear sense of direction, will find them on the whole less satisfactory than the first part of the study.

The remainder of the work shows how far Canada has progressed since the first World War, both in the understanding of the principles of war finance and in the ability and will to put them into practice. In contrasting financial policies and their effects in the two World Wars the author takes due account of the relative smallness of the war effort in the previous war and the correspondingly minor use made of direct controls over the allocation and prices of goods and services.

WILLIAM H. WYNNE

Office of Civilian Requirements
War Production Board

Steel in Action, by Charles M. Parker. Lancaster, Pennsylvania: The Jacques Cattell Press. 1943. vi, 221 pp. $2.50.

This book is designed to tell its readers what steel is, how it is made and what part it has played in serving America in peace and in war. Nearly half of the volume is devoted to a description of the physical processes of steel making. This part of the book is one of the best simple treatments of the subject this reviewer has ever read. The brief historical chapter is also well handled. In the latter part of the book which is concerned with the control of raw materials, wartime expansion, and markets, the author deviates occasionally from description in order to philosophize a bit on such subjects as the desirability of living in the United States and the reasons why the United States has become a great nation. These digressions tend to detract somewhat from the clarity of the presentation. One chapter describes the expansion of the industry during the present war and the adaptability of the industry's technicians to wartime problems. No comments are made, unfortunately, on the many issues raised by competing proposals for expansion.

Almost no treatment of the economics of the industry is included, except that which is incidental to a discussion of raw materials sources. The author attaches considerable importance to the relation of the location of iron ore reserves to peace negotiations. In his comparison of the steel industries of the world he overemphasizes United States industrial and metallurgical superiority. From a statistician's standpoint the book is not useful as a source of factual information, nor is it intended to be. The chapter on the steel industries of the world has, however, a good brief description of the sort of steel capacity controlled by the main producing countries in the world. For those not familiar with the industry this chapter, like the earlier chapters on production, has the advantage of giving as much information as the average reader needs.

In the latter part of the book, some of the recent advances in technology are reviewed in terms which should be understood by the casual reader, without using the ecstatic expressions so frequently found in popular books and articles. The author's views of the post-war markets—both domestic and foreign—seem rather optimistic. He touches only slightly on competing materials, such as aluminum, plastics, etc., stating that all will participate in the markets "but the workhorse will be steel."

Taken as a whole the book contains much useful information for a reader who is looking for general factual information. It is, however, too limited in scope to be of much value to a serious student of the economics of the industry. Because of its popular nature, it is too bad that it contains so few diagrams and pictures.

MARION WORTHING

War Production Board

The Geography of World Air Transport, by J. Parker Van Zandt. Washington: The Brookings Institution. 1944. viii, 67 pp. $1.00.

This is the first of three projected volumes. The second will be on the relation of civil aviation to military power, the third on organization and operation of world air transport. The present volume is primarily devoted to clearing away various popular misconceptions as to the geography of international aviation. The book is easy reading and should contribute to public understanding.

Aviation specialists will find the book of value because of the skill with which the author has clarified his materials to bring the most important geographic relationships into sharp focus. This is achieved partly by concentrating attention on "the principal hemisphere," that half of the globe which includes 94 per cent of the world's people and 98 per cent of all industrial activity. Air routes of primary economic importance are further identified by an analysis of basic statistical material in terms of eight major world trade areas. The tabulations in Appendix B may prove convenient for use by statisticians interested in a variety of global matters. Appendix A is devoted to an ingenious device developed by the author to facilitate great circle computations on flat maps.

PAUL T. DAVID

Washington, D. C.

New Firms and Free Enterprise, by Alfred R. Oxenfeldt. Washington: American Council on Public Affairs. 1943. ii, 196 pp. $2.50.

In treating the life cycle of business enterprises the author departs from the usual analysis of business mortality and directs his study to the birth of new firms. The timeliness of such a treatment when everyone is thinking of new businesses in the postwar period is emphasized in a preliminary note.

New firms have economic significance in that they influence: (1) the allocation of resources, (2) the outlets for investment goods and investible funds, (3) the introduction of new products and new methods of production and sale, (4) the intensity of competition, (5) the waste of resources, and (6) the economic and social advancement of individuals. The effect of the establishment of new firms upon each of these phases of the economy is outlined with clarity and considerable precision.

By putting various data together, Dr. Oxenfeldt has developed some interesting statistics. For instance, between 1936 and 1940 on the average 160,000 businesses were completely new, and about 270,000 had elements of newness. The volume of new enterprises reached its peak in 1925. In the years immediately preceding the outbreak of the war new businesses were considerably fewer than in any year during the decade of the 1920's. The chances that an individual will establish a business during his lifetime, if no individual entered more than one business, is about one in five; however, on the average, entrepreneurs establish about three firms each, so it may be

estimated that one out of every 15 persons at some time becomes an entrepreneur.

Not the least interesting of the points discussed is the author's analysis of the unrealistic approach of economists who assume that most entrepreneurs have information as to the profit-making possibilities of various businesses, or that they use the information which is available rationally. In this, as in many other parts of the discussion, the author faces the difficult task of generalizing about things that are essentially different, such as entrance into the grocery business and entrance into the steel manufacturing business. In the latter case close study of opportunities is undoubtedly a requirement for beginning a new business, as a number of experienced capitalists have to be convinced of profit-making possibilities before risking their money; the small retailer, on the other hand, aided and abetted by those who will gain by his excursion into the unknown, is usually unable or unwilling to face the facts and simply takes a chance. In like manner, it can be pointed out, that, although the desire to avoid unemployment or to lift one's social status may motivate large numbers to enter the grocery business, these reasons probably have little influence on the enterpreneurs entering the steel business.

In view of his conclusions that (1) "most profitable opportunities . . . are eventually discovered," (how the opportunities which are not discovered can be counted is not explained), (2) new firms add to the cost of distribution and production when they duplicate facilities which are already adequate, (3) most new firms seem to be a source of waste, (4) new enterprises seem to impair rather than contribute to economic welfare, Dr. Oxenfeldt's recommendation that a specialized government organization be created to lend to new firms, seems hardly justified, even if "the establishment of a concern provides some individuals with an escape from unemployment and others an escape from the humiliation that sometimes attaches to employment in the business of another."

E. D. McGARRY

University of Buffalo

The Labor Force in Wartime America, by Clarence D. Long. New York: National Bureau of Economic Research. 1944. 73 pp. 50 cents.

After examining the nature and extent of manpower mobilization in the United States, Great Britain, and Germany during World Wars I and II, Mr. Long concludes that "the possibilities of net additions to the normal labor force in wartime have been exaggerated." By "net additions," Mr. Long means expansion of the labor force through bringing in, as workers and soldiers, persons who would not be there in peacetime. This excludes increases in total labor input resulting from more intensive utilization of the existing labor force through lengthening hours of work or reducing unemployment.

Mr. Long believes that the additions to the American labor force during World War I were almost wholly "illusory." He develops this point, first by attempting to show that the estimates of the National Industrial Conference Board, which indicate that employment in 1918 exceeded the "normal" labor force by more than 3 million, were grossly in error, and second by advancing evidence to indicate that wartime additions of students and women to the labor force were negligible. The arguments are not convincing, however, because they are predicated upon assumptions which appear questionable in the absence of detailed supporting data (see below).

Even the acceptance of Long's belief that abnormal additions to the American labor force during World War I were virtually non-existent would not necessarily imply the acceptance of the general conclusion that the wartime expansibility of the labor force is limited. For the United States the last war was of relatively short duration and one which did not tax severely the manpower resources of the Nation. The same cannot be said of Britain and Germany, however, and Long also discusses the experience in these two countries. He points out that Germany suffered a net loss of 18–20 per cent in the civilian labor force and Great Britain a loss of 10–13 per cent. But the expansion in the armed forces according to Long amounted to approximately 33 per cent of the normal labor force in Germany and 25 per cent in Britain. Do these figures support the conclusion that wartime additions to the Labor force were largely "illusory"? Indeed, it would appear to this reviewer that they tend to support exactly the opposite conclusion: They indicate that the total labor force (civilian and military) in both Germany and Britain expanded in the order of 12–15 per cent over normal. This is approximately the same degree of expansion that has occurred in the United States during the current war. According to the Bureau of Labor Statistics the total labor force in the spring of 1944 exceeded normal peacetime expectations by approximately 6½ million or 12 per cent.

Long's conclusion that the "possibilities of net additions to the normal labor force in wartime have been exaggerated" would indicate that this increase of 6½ million in the labor force is smaller than was expected at the beginning of the war. Yet recollections of discussion on manpower problems during the early days of the war and reference to Congressional testimony taken at that time suggest that the possibilities for expansion in the labor force were underestimated rather than exaggerated. During 1942 a decision was reached setting the objective size of the armed forces at about 10 million. It was felt, however, that mobilization of men on this scale could not be achieved without either a more drastic curtailment of employment in the so-called "nonwar" industries or a more rigorous administrative control of the labor market than has in fact proved necessary. As a matter of fact the net strength of the armed forces is now approaching 12 million, and we are producing munitions in a volume not anticipated in 1942.

The data presented by Long also show substantial increases in the American, British and German total labor forces during World War II and he does

not ignore this fact. Apparently, however, his standard of an expansible labor force is ability to replace all civilian workers who are drawn into the armed forces, for in support of his general conclusion he points out that "none of the three countries was able in either war to keep up its civilian labor force from its native population."

The wartime rise in the percentage of the population in the labor force has been approximately the same in the United States as it has been in Britain. In Britain, however, the pre-war worker rate was much higher than in this country so that 70 per cent of the population aged 14–64 were in the labor force at the peak of wartime mobilization in 1942 as compared with only 60 per cent for the United States in late 1943. The higher British worker rate, Long points out, is not a feasible goal for the United States because it reflects two longstanding differences in the social and demographic structures of the two countries, namely, the traditionally smaller percentage of British children over 14 attending school and the smaller percentage of British women with young children to care for.

The fact that the percentage of British women who live in nonfarm areas is much greater than the corresponding percentage for this country also contributes to the higher worker rate found among British women and tends to support Long's conclusion that the differences in labor force participation between the two countries are set deep in their social and economic structures. He does not classify the difference in the farm-nonfarm distribution of the populations as an independent factor, however, because he feels that the lower worker rates found among farm women are merely a reflection of the fact that a much greater proportion have children to care for. But a glance at the returns from the 1940 Census reveals that even when the women with children or women without children are considered separately, the percentage of farm women in the labor force is only about half as great as the corresponding percentage for nonfarm women. In this connection it might be remarked that Long apparently overlooks the effect of increasing urbanization as one of the factors explaining the rise in the percentage of working women in the United States between the two World Wars. He stresses the declining birth rate, which was no doubt the most important factor, and also mentions the lightening of household duties made possible by modern mechanical appliances and the ability to buy goods and services formerly made or performed in the home.

The extra persons who have been drawn into the civilian and military labor force of the United States during the war will, in Long's opinion, most likely drop out at the war's end, leaving the labor force larger than in pre-war days only by reason of population growth. It is reasonable to assume, as Long does, that a large number of young married women will quit work after the war if their husbands can support them. But the older married women have been the chief source of additional adult workers during the war. These women, whose family responsibilities are mostly in the past, have been given their first good job opportunities by the wartime demands

for labor and many of them may wish to continue working when the war is over. Similarly, those older men and marginal workers who were unwilling to expose themselves continuously to the rebuffs of the pre-war labor market, but who are now at work, will remain in the labor force if employment opportunities are favorable when the war is over. On the other hand if post-war employment conditions are generally unfavorable, many of the married women who might otherwise have dropped out of the labor market may be compelled to seek work in order to bolster the family income. All in all it seems more reasonable to assume that perhaps 2–3 million of the 6–7 million extra wartime workers will remain in the labor force during the first year or so after final victory and that 1–2 million will continue in the labor market thereafter. Certainly this is a safer assumption from the standpoint of appraising the magnitude of the post-war employment task.

It would appear from his footnotes that, as a basis for the preparation of this paper, Long has done a detailed analytical job in adjusting decennial Census data for various incomparabilities as well as a painstaking research job in gathering from both primary and secondary sources a great deal of material on population, labor force, school attendance, birth rates, etc. It is unfortunate, however, that a detailed description of the basic data and the estimating procedures has been reserved for later publication because some of the estimates—although they may be perfectly sound—are open to question in the absence of supporting data that can be evaluated by the reader. This is particularly true in the case of the Census adjustments, which conflict with those published by the Census Bureau. For example, Long has *increased* the gainful worker totals for 1910, 1920, and 1930 in order to adjust them for comparability with the labor force as defined in 1940, despite the fact that it is generally agreed that "labor force" is on balance a less inclusive concept than "gainful workers." Only the 1930 gainful worker figures have been adjusted to a labor force base by the Census Bureau and this adjustment involved a net *decrease* of approximately 1,200,000 from the gainful worker total as reported in 1930.

One other case in point is provided by the overcount in the Census of 1910 which was estimated by Long at 1,400,000, but by the Census Bureau at only 800,000. Moreover, Long apparently ignores an undercount of approximately 800,000 in the Census of 1920. This apparent oversight plus the questionable nature of his adjustments greatly weaken his case against the validity of the National Industrial Conference Board's estimates for the period of World War I.

Despite the technical shortcomings and questionable conclusions of this paper, it is significant as a beginning in a field of research which has heretofore been neglected largely because of the lack of adequate data by which to measure short-run changes in the size and composition of the labor force. Since the inception of the sample *Monthly Report on the Labor Force* (initiated in 1940 by WPA and taken over in 1942 by the Census Bureau), it has become possible to study the nature and extent of these short-run changes. As more experience is gained, continued progress should be made toward

appraising the effect of both demographic and economic changes on the size and composition of the labor force.

Leonard Eskin

Bureau of Labor Statistics

Wage Determination under Trade Unions, by John T. Dunlop. New York: The Macmillan Company. 1944. ix, 231 pp. $3.50.

The task of evaluating this book is made difficult by the multitude of subsidiary aims encompassed within this "tentative reconnaissance of some of the more prominent and obvious features of the pricing [of labor services] terrain." For this major task, the author has assembled a large array of wage-rate and wage-policy case histories, and has attempted to construct theoretical models of trade union-employer bargaining. These are intended to provide an analytical framework that may be clothed by case histories and institutional studies.

In scrutinizing a vast assemblage of trade union actions and policies, the author has done a competent and useful job. Particularly valuable, in the reviewer's opinion, is the detailed discussion of differences between the bourse-type market assumed by the neo-classical school for all product and factor markets, and the quoted-price market that, in the absence of trade unions, has become characteristic of labor markets in which the large employer hires labor. The function of the trade union, under these conditions, is to change the market into a negotiated price market, thereby in effect restoring a certain amount of competition to a monopsonistic market.

Useful, too, are the discussions of (1) the distinction between short-term impacts and long-term stabilized conditions; (2) the implications of the observed fact that wage rates are set chiefly in terms of the latter, and that neither side to the bargain will customarily press its momentary bargaining advantage to the utmost; (3) the qualification of the term "wage-rate" to correspond, not to a unique and simply-determined magnitude but to a conglomerate of conditions, some of them non-pecuniary, that may be extremely difficult to express in terms of wage-rate levels; (4) the examination of union participation in product markets; (5) the careful distinction between hourly wage-rates and hourly earnings, and the examination of their relative movement in time (useful in relation to the excessive-wage controversies of 1938–40).

Yet all of these points are hardly novel. They have been made, not only by scholars, but also by the unions in their various public statements. What is novel in this book, is an attempt to provide a theoretical (mathematical) model, that can serve to orient discussion of particular cases. Although a good deal of ingenuity has been expended on this effort, the results do not warrant this expenditure.

A theoretical model, if it is to be workable, must abstract from most of the "disturbing" facts, and yet retain an accurate expression of the forces that determine the movement or position of the system. In other words, a

model should delineate the most general features of the area it is intended to describe. Now Mr. Dunlop has chosen for his tools the indifference calculus developed by Alfred Marshall and F. Y. Edgeworth (as distinct from the type recently employed by Bowley, Allen and others). From the assumption of a family of indifference curves for employers and employees, he has derived supply and demand curves for labor, as well as a contract curve that represents the locus of all possible contracts between employers and employees. These families of curves, further modified by specific assumptions, yield relative wage rates under varying degrees and combinations of competition in both product and factor markets, as well as wage rates that will result from a trade union's efforts to maximize a given objective, in this case the total wage bill for a group of workers as defined by the union's membership function.

Marshall's utility calculus, however, was developed for the analysis of static partial-equilibrium states. Mr. Dunlop specifically rejects this approach and claims that his curves may be used to represent a modified general-equilibrium situation. Now such an analysis should (even when limited to clusters of markets) specify the inter-commodity and inter-factor relationships, possibly in the form of a set of simultaneous equations connecting prices and quantities of both factors and commodities. Even more important, if a firm bond is to be established between the model and the real world, it is necessary to prove first that wage bargains are customarily struck in near-equilibrium positions. Yet certainly revisions in wage rates occur most frequently in conditions of rapid change, usually cyclical. Moreover, the study of frictions in the rate of adjustment to new equilibrium positions has demonstrated that lags in the adjustment of supply-demand-price relationships and of the Keynesian propensities, and in general that the failure of expectations to match developments, can easily cause and perpetuate fairly violent oscillations. But most crucial, in the reviewer's opinion, is the neglect, in constructing the theoretical model, of the distinction between voluntary and involuntary unemployment.

In view of the above, it is hardly surprising that the author derives a negatively sloping demand curve for labor—thus implying the inability of trade unions to raise wages except at the expense of employment. Equally certain to follow from hidden premises is the conclusion that perfect competition in all markets will maximize employment. But the contention, qualified to be sure, that workers in monopsonistic industries will enjoy a higher wage than workers in monopolistic industries is rather surprising in the light of the fact that a good many of the sweat-shop industries are or were composed of small producers selling to large buyers. Finally, the series of curves presented in Chapters III and V hide certain assumptions that seem at least peculiar under any specification of a general state. Thus, the unemployment insurance employee-income line, as drawn, seems to imply that any worker is eligible for constant insurance payments for an indefinite period, presumably only by virtue of declaring himself to be a part of the

labor force of the industry, or union membership, at the current wage rate. Lack of space forbids mentioning others.

On balance it is unfortunate that Mr. Dunlop, though keenly aware of the rich diversity of trade union wage-setting activity under actual conditions, should have developed theoretical models that are not only weak in construction, but also yield the type of conclusion that he usually explicitly rejects in other parts of his book.

JACOB GRAUMAN

Washington, D. C.

Gauging Public Opinion, by Hadley Cantril. Princeton: Princeton University Press. 1944. xi, 318 pp. $3.75.

Public opinion polls are likely to become more numerous rather than less. It is said that this field of private enterprise is quite lucrative, especially that part of it that deals with market analyses and consumer preferences. It is also being said that polls can have a great influence in the political field. The examples cited are:

(a) The influence of the National Republican Convention Delegates of the Gallup Polls showing Mr. Dewey's popularity among Republicans, and

(b) The influence among Democrats of the Gallup Poll some months ago showing Mr. Wallace's real popularity as Democratic Vice Presidential candidate among Democrats.

Developments of this sort assure the growth of the polling industry for some time to come in both business and politics. If polls can have even half the influence claimed for them, it is essential that their weaknesses and degree of reliability be more generally understood.

For this reason, *Gauging Public Opinion*, by Professor Hadley Cantril and his research associates will be doubly welcome. Those who are, and are going to be, engaged in the art of interviewing will find this volume extremely useful for both specific technical information as well as general principles.

The five parts of the book deal with problems involved in "setting the issues," problems connected with interviewing, problems in sampling, problems in getting opinion "determinants," and the polling technique applied to a specific problem, namely, the measurement of civilian morale in the United States during the two years before Pearl Harbor and the months following. The last part of the book on our attitudes toward the war and the trends in those attitudes will interest students for many years to come. The rest is a scholarly objective work on the art of public opinion polling, its pitfalls, and "the serious problems encountered in every phase of the polling operation"—a most necessary contribution in a rapidly growing field of activity.

Readers of the book and many others who have heard the Gallup Polls both praised and damned will be interested in the fact that Dr. Gallup has turned the original data of the surveys of his American and British Institutes of Public Opinion over to Professor Cantril for critical analysis. Many of the

studies covered in this volume make use of the Gallup material, as well as the surveys of the Office of Public Opinion Research.

LOUIS H. BEAN

Bureau of the Budget

The Structure of Soviet Wages, by Abram Bergson. Cambridge, Massachusetts: Harvard University Press. 1944. xiv, 255 pp. $3.50.

Professor Bergson has studied the structure of the Soviet Union with a view of determining the degree of wage inequality, and whether the inequality in wages is similar to that existing in capitalist countries. The measure adopted is "the ratio of the workers whose earnings are higher than those of 25 per cent and lower than those of 75 per cent of the workers to the wage of the workers whose position in the frequency distribution is the opposite." He concludes, after a careful investigation of eight industrial groups, that inequality of wages was less in 1928 than in the pre-revolutionary year of 1914. A reversal in the direction of greater inequality then took place, and in 1934 the inequality in the wages paid different groups of workers in the Soviet Union was greater than 1928. The wage principles used in the Soviet Union are, in his opinion, capitalist principles.

The study is a painstaking investigation with every point carefully documented. While under socialism as well as capitalism relative wages can reflect the attractiveness or disutility of specific types of work, there is still a question of how the basic wage, or the wage from which all others are measured, is calculated. Professor Bergson has not discussed this problem as it perhaps does not fall within the scope of his study. Yet this is an important question in examining the structure of wages; for while wage differentiation may properly reflect the relative valuation placed upon different types of work by labor and administrators, the amount of wages paid may be woefully small as compared with what the economy is able to pay. If the size of the consumption fund for labor, or the part of the real income set aside for the payment of wages, is determined solely by administrative decision, it follows that the administrator can divert arbitrarily any amount of the annual income into nonconsumption, or investment channels, providing the amount were enough to provide for customary standards or even subsistence. There is little in Professor Bergson's study to tell us how wages are set, and by whom; or the role of labor unions and collective bargaining.

In discussing the trend towards inequality, Professor Bergson omits an examination of the political changes and class differentiation that have taken place in the Soviet Union, especially since the defeat of the Trotskyist opposition in 1927. It would be interesting to inquire if increased inequality reflects the rise of a bureaucratic ruling class, less interested in Socialist equalitarianism than were the founding fathers of the revolution.

The question of equality of wage payment under Socialism is touched on

briefly, but the intimation that Socialist writers believe in inequality of wage payment under Socialism does not seem correct. Even the quotation from the *Gotha Program* indicates that Marx believed in equality of payment as an ideal to be ultimately realized in the distant Socialist future. The question therefore arises, why a Socialist society is moving from, rather than towards, these ideals. Perhaps inequality in earnings is a reflection of the disparity in power of the different groups in Soviet society.

Philip Taft

Brown University

Institutions Serving Children, by Howard W. Hopkirk. New York: Russell Sage Foundation. 1944. xiv, 244 pp. $2.00.

The author of this timely volume writes out of years of experience as director of recreation, cottage father, superintendent of an institution for dependent and neglected children, and for a decade as a member of the staff and now Executive Director of the Child Welfare League of America.

The treatment of the historical development of asylums or orphanages into schools and homes for children includes the broader aspects of recent public and private community services for children and a discussion of some of the current programs that have grown out of wartime necessity.

The author points out that lack of consistency in the methods used in the enumeration of children by the Bureau of the Census, in its decennial counts of children in institutions undertaken from 1880 to 1933, limits comparison of various types of services. The data available for the state of New York from 1911 to 1942 are said to show the trend toward use of foster-family homes. The author states that the use of different types of care varies in different states and regions, and that New York as elsewhere is doubtless affected by the program of the assistance to children in their own homes available through the aid to dependent children provisions of the Social Security Act. Nevertheless the number and proportion of children in institutions indicate the continuing importance of this type of care.

A complete section on staff discusses qualifications, training, and working conditions. The brief discussion of the cost of institutional care is of necessity limited by lack of available comparable data.

The major portion of the book is devoted to discussion of those aspects that affect the child most deeply and directly. The chapters on personal relationships of the child and on his education, training, and physical care contain constructive criticism and practical suggestions for the improvement of present standards of care.

The concluding chapter on self-criticism and surveys should stimulate critical evaluation of programs that in many instances is long overdue.

Elsa Castendyck

Children's Bureau
U. S. Department of Labor

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Davis, Malvin E. *Industrial Life Insurance in the United States.* New York: McGraw-Hill Book Company, Inc. 1944. xii, 399 pp. $2.75.

Ducoff, Louis J. *Wages of Agricultural Labor in the United States.* Washington: United States Department of Agriculture, Bureau of Agricultural Economics. 1944. 193 pp.

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Moulton, Harold G. and Louis Marlio. *The Control of Germany and Japan.* Washington: The Brookings Institution. 1944. xi, 116 pp. $2.00.

Pinto, P. J. J. *System of Financial Administration in India.* Bombay: New Book Company. 1943. xi, 435 pp. 15 rupees.

Roberts, Warren A. *State Taxation of Metallic Deposits.* Cambridge: Harvard University Press. 1944. xiv, 400 pp. $4.50.

Society for Advancement of Management, Compiled by the Student Chapter of. *A Survey of Personnel Services.* Minneapolis: University of Minnesota. 1944. 67 pp.

von Neumann, John, and Oskar Morgenstern. *Theory of Games and Economic Behavior.* Princeton: Princeton University Press. 1944. xviii, 625 pp. $10.00.

Williams, John H. *Postwar Monetary Plans and Other Essays.* New York: Alfred A. Knopf. 1944. vii, 297 pp. $2.50.

* Annual reports and publications presenting statistics collected at regular intervals have been omitted from this list. Some items of minor interest to statisticians have also been omitted. The contents of periodical publications are not listed, but the attention of the reader is directed to the lists of articles in current publications which are to be found in the *Revue de l'Institut International de Statistique, Journal of the Royal Statistical Society, American Economic Review, Population Index, Transactions of the Actuarial Society of America, The Record of the American Institute of Actuaries,* and *Sankhyā, The Indian Journal of Statistics.*—Editor.